

R263-96
Addendum 1
28 November 1996

**Addendum 1 to Document R263-96
Proposed Loan and Technical Assistance Grant
Second Power Development Project
(Tonga)**

Please add the attached Appendix 17, page 7 to the Report and Recommendation of the President (RRP:TON 23367) of the above-mentioned document.

**TA Cost Estimates and Financing Plan
(US\$)**

Item		Foreign Exchange	Local Currency	Total Cost
A. Bank Financing				
1.	Consultants			
	a. Remuneration and Per Diem			
	- International Consultants	208,000	—	208,000
	b. International Travel	35,000	—	35,000
	c. Reports and Communications	7,000	—	7,000
2.	Miscellaneous Administration & Support Costs	5,000	—	5,000
3.	Representative for Contract Negotiations ^a	6,000	—	6,000
4.	Contingencies	39,000	—	39,000
	Subtotal (A)	300,000	—	300,000
B. Government and TEPB Financing				
1.	Remuneration and Per Diem of Counterpart Staff	—	9,000	9,000
2.	Office Accommodation, Local Surface, & Interisland Transport	—	8,000	8,000
3.	Communications, Printing, & Supplies	—	4,000	4,000
4.	Contingencies	—	3,000	3,000
	Subtotal (B)	—	24,000	24,000
	TOTAL	<u>300,000</u>	<u>24,000</u>	<u>324,000</u>

^a Representing a total of 10 person-months.

^b Costs of one representative.

**BOARD
OF
DIRECTORS**

ASIAN DEVELOPMENT BANK

FOR OFFICIAL USE ONLY

(For consideration by the Board
on or about 3 December 1996)

R263-96

12 November 1996

**PROPOSED LOAN AND TECHNICAL ASSISTANCE GRANT
SECOND POWER DEVELOPMENT PROJECT
(TONGA)**

1. The Report and Recommendation of the President (RRP:TON 23367) on a proposed loan and technical assistance grant (JSF-financed) to Tonga for the Second Power Development Project is circulated herewith, together with the following attachments:

(a) (Draft) Loan Agreement

(b) (Draft) Project Agreement

2. This Report and Recommendation should be read with (a) Tonga: Economic Performance and Selected Development Issues published in June 1996 in the Pacific Studies Series; and (b) an Update, which were circulated to the Board on 30 October 1996 (DOC.IN.227-96).

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The attached document has a restricted distribution until it has been approved by the Board of Directors. Following such approval, the document will be available to the public upon request.

RRP:TON 23367

ASIAN DEVELOPMENT BANK

**REPORT AND RECOMMENDATION
OF THE
PRESIDENT
TO THE
BOARD OF DIRECTORS
ON A
PROPOSED LOAN
AND TECHNICAL ASSISTANCE GRANT
TO THE
KINGDOM OF TONGA
FOR THE
SECOND POWER DEVELOPMENT PROJECT**

November 1996

CURRENCY EQUIVALENTS

(as of 31 October 1996)

Currency	--	Pa'anga (T\$)
T\$1.00	=	\$0.80
\$1.00	=	T\$1.25

In this Report, a rate of \$1.00 = T\$1.25 has been used, which was the rate generally prevailing at the time of Project appraisal.

ABBREVIATIONS

AusAID	-	Australian Agency for International Development
ADO	-	Automotive Diesel Oil
BME	-	Benefit Monitoring and Evaluation
DP	-	Direct Purchase
DSR	-	Debt-Service Ratio
EIRR	-	Economic Internal Rate of Return
ENPV	-	Economic Net Present Value
EPU	-	Energy Planning Unit
EU	-	European Union
FIRR	-	Financial Internal Rate of Return
GDP	-	Gross Domestic Product
I & C	-	Indication and Control
ICB	-	International Competitive Bidding
IEE	-	Initial Environmental Examination
IS	-	International Shopping
LRMC	-	Long-run Marginal Cost
MIS	-	Management Information System
MLSNR	-	Ministry of Lands, Survey and Natural Resources
NEPS	-	National Energy Policy Statement
O & M	-	Operations and Maintenance
PV	-	Photovoltaic
ROR	-	Rate of Return
TA	-	Technical Assistance
TEPB	-	Tonga Electric Power Board
UNDP	-	United Nations Development Programme

MEASURES

A	(ampere)	- Unit of current
V	(volt)	- Unit of voltage
VA	(volt-ampere)	- Unit of apparent power
kV	(kilovolt)	- 1,000 volts
kVA	(kilovolt-ampere)	- 1,000 VA
kVAr	(kilovolt-ampere reactive)	- Unit of reactive power
W	(watt)	- Unit of active power
kW	(kilowatt)	- 1,000 W
MW	(megawatt)	- 1,000 kW
MWh	(megawatt-hour)	- 1,000 kWh
Wh	(watt-hour)	- Unit of energy
kWh	(kilowatt-hour)	- 1,000 Wh

NOTES

- (i) The fiscal year (FY) of the Government and TEPB ends on 30 June. "FY" before a calendar year denotes the year in which the fiscal year ends, e.g., FY1996 ends on 30 June 1996.
- (ii) In this Report, "\$" refers to US dollars and "T\$" to the Tongan pa'anga.

GLOSSARY

Available Capacity	-	Power output capacity of a generating unit equal to 85 percent of its nominal maximum output.
Capacity Balance	-	A system's power output capacity equal to the difference between its firm capacity and its peak demand.
Firm Capacity	-	Maximum power generating capacity of a system after subtracting reserve capacity allowance.
Installed Capacity	-	Total power output capacity of a system's power generating plants (the sum of the maximum power outputs of the individual units).
Load Factor	-	Ratio of average system power demand to maximum system power demand.
Peak Demand	-	Maximum power demand (load) of a system within a certain period of time.
Plant Factor	-	Energy output of a power generating unit (or group of units) compared with the maximum possible energy production capability of that unit (group of units).
Reserve Capacity	-	Power output capacity (usually equal to capacity of the largest generating unit in the system) to allow for a generator's forced outage or maintenance.

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LOAN AND PROJECT SUMMARY

Borrower	:	Kingdom of Tonga
Project Description	:	The Project covers the rehabilitation and expansion of diesel generating plants, and the rehabilitation of distribution systems in the four main island power systems of the Tonga Electric Power Board (TEPB). The Project is consistent with the Bank's Pacific strategy of support for building strong, self-sufficient utilities, and in providing the infrastructure necessary for private sector development.
Classification	:	Economic growth
Environmental Assessment	:	Category B An initial environmental examination was undertaken.
Rationale	:	The Project is to ensure the continued provision of reliable electric power supply to support the economic development of the Kingdom. It also supports the Government's energy sector policy of providing least-cost power generation and distribution facilities and ensuring maximum efficiency of operation and maintenance. The Project builds on earlier Bank sector work in Tonga and provides for capacity building of the Executing Agency (TEPB) in its progress toward self-sufficiency, corporatization, and improved management and accounting.
Objectives and Scope	:	<p>The objective of the Project is to provide adequate power generating capacity to TEPB's two largest power systems on Tongatapu and Vava'u islands. The generating capacity is needed to replace/rehabilitate existing aging diesel plant and to meet the increasing demand on the systems. In addition, the Project will assist in capacity building and further corporatization and commercialization of TEPB. The Project covers four areas:</p> <ul style="list-style-type: none"> (i) Generation plant rehabilitation. Rehabilitation of the older section of the Popua diesel power station on Tongatapu island including rehabilitation of the four old diesel generating units (units 1 & 2 of 1,200 kW; units 3 & 4 of 1,730 kW) including major overhaul of three of the four generating units, rehabilitation of auxiliary equipment, controls, station services plant, and powerhouse facilities and structures;

- (ii) Generation plant expansion. The addition of two 300-kW diesel generators in the new Taumu'aloto diesel power station in Vava'u to replace the four old 150-kW sets in the Neiafu power station, which will be decommissioned;
- (iii) Distribution systems upgrading. Upgrading of power distribution facilities to reduce losses in the four systems on Tongatapu, Vava'u, Ha'apai, and 'Eua islands; improvements to the transmission arrangements to increase system efficiency; and
- (iv) Distribution infrastructure improvements. Upgrading of various facilities in the four distribution systems; including switchgear replacement and improvements to system control facilities to increase security of supply and efficiency of operation.

In addition, the Project provides for 24 person-months of consulting services as well as for the procurement of equipment and materials.

Cost Estimates

The total cost of the Project is estimated at \$7.1 million equivalent, of which \$4.9 million (70 percent) is the foreign exchange cost and \$2.2 million equivalent (30 percent) is the local currency cost. The cost estimates incorporate provisions for physical contingencies, price escalation, and loan service charges during construction.

(\$ million equivalent)

Item	Foreign Exchange	Local Currency	Total Cost
Part A: Generation Plant Rehabilitation	1.5	0.7	2.2
Part B: Generation Plant Expansion	0.4	0.2	0.6
Part C: Distribution Systems Upgrading	0.9	0.5	1.4
Part D: Distribution Infrastructure Improvement	0.1	0.1	0.2
Part E: Equipment and Materials	0.5	--	0.5
Consulting Services	0.4	0.2	0.6
Contingencies	0.9	0.5	1.4
Loan Service Charges	<u>0.2</u>	<u>--</u>	<u>0.2</u>
Total	4.9	2.2	7.1

Financing Plan : (\$ million equivalent)

Source	Foreign Exchange	Local Currency	Total Cost	Percentage of Total
Bank	4.9	—	4.9	70
TEPB	—	2.2	2.2	30
Total	4.9	2.2	7.1	100

Loan Amount and Terms :

A loan of SDR 3,403,000 equivalent (currently \$4.9 million) from the Bank's Special Funds resources with a repayment period of 40 years including a grace period of 10 years, and carrying a service charge of 1 percent per annum. The loan will be lent to TEPB with interest at rates equivalent to at least the Bank's US dollar ordinary capital resources rates, currently at 6.82 percent per annum, with a maturity of 20 years including a grace period of 5 years.

Period of Utilization :

Until 30 June 2002

Executing Agency :

Tonga Electric Power Board (TEPB)

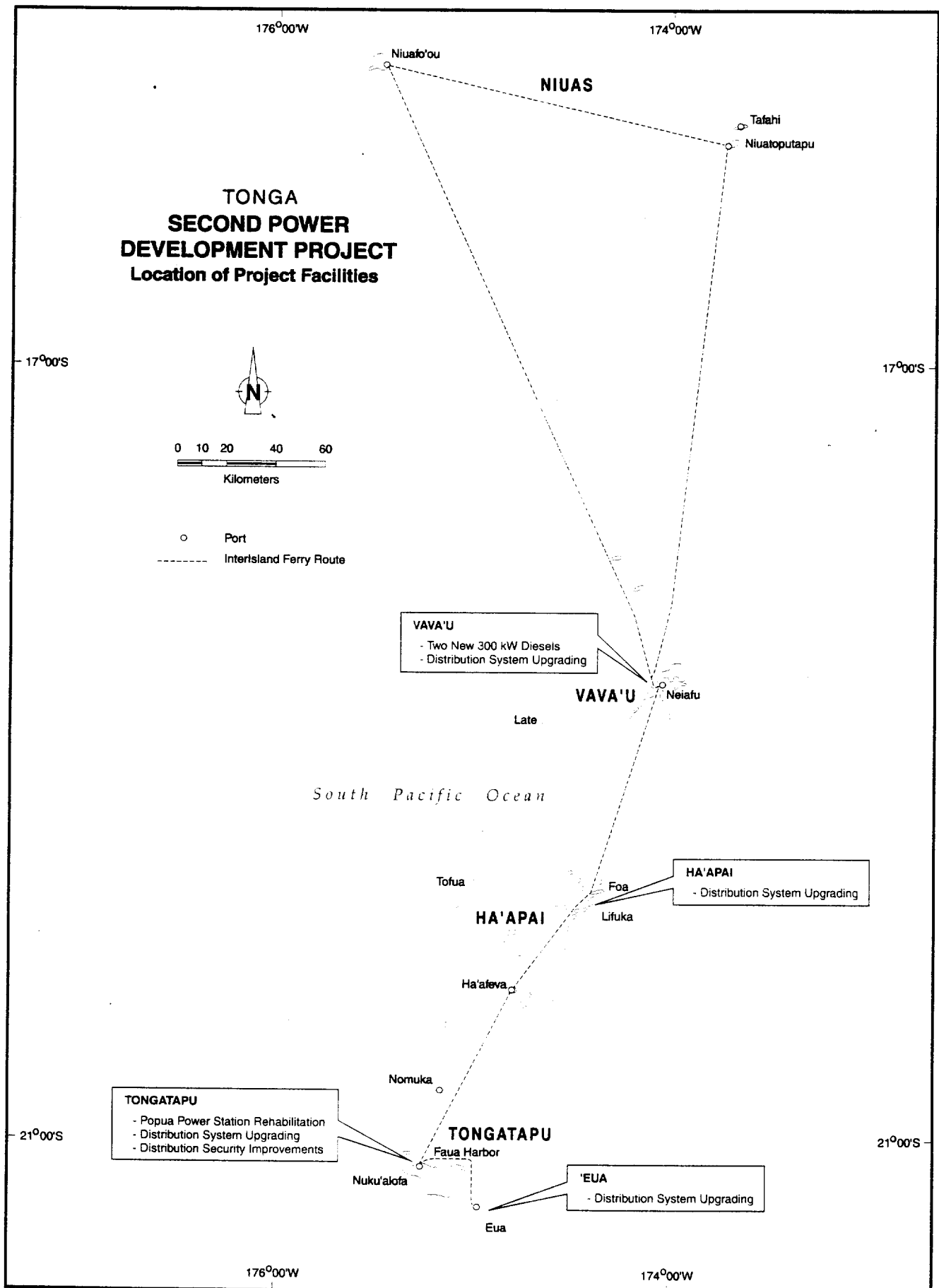
Implementation Arrangements :

The Project will be implemented by TEPB. A Project Office will be established by TEPB to be responsible for the management of all Project activities. TEPB will be assisted by consultants in the detailed design of the generation and distribution components and in procurement and construction supervision of the generation plant rehabilitation and expansion contracts.

Procurement :

All procurement to be financed under the loan will be in accordance with the Bank's *Guidelines for Procurement*. The largest Project contract, to cover equipment and materials for the Tongatapu generation plant rehabilitation component, will be arranged under the Bank's international competitive bidding procedures. The generation plant expansion contract for Vava'u will be awarded under the direct purchase procedure. Distribution materials and other small items will be procured by either international shopping or direct purchase procedures in accordance with the Bank's *Guidelines for Procurement*.

Consulting Services	:	About 24 person-months of consulting services are required to assist with the implementation of the Project. The consultants will be engaged in accordance with the Bank's <i>Guidelines on the Use of Consultants</i> .
Estimated Project Completion Date	:	31 December 2001
Project Benefits and Beneficiaries	:	<p>The Project will provide improved power supply reliability and reduce operating costs by rehabilitating existing generation plant. Also, additional power generating capacity will be installed to meet the growing demand in one of TEPB's power supply systems. The efficiency of the distribution systems will be enhanced by the provision of energy loss reduction measures and their reliability improved through upgrading of lines, switchgear and improvements in remote control facilities.</p> <p>Geographically balanced growth will be supported by the enhancement of the outer islands systems as well as the main Tongatapu power system. The beneficiaries of the Project will be the existing and future commercial, industrial, and residential consumers in the four main islands of the Kingdom.</p>
Technical Assistance	:	An associated technical assistance (TA) in the amount of \$300,000, for which the Ministry of Finance will be the Executing Agency, is proposed. The TA will have two components: (i) institutional development of TEPB, for which TEPB will be the implementing agency; and (ii) institutional development for rural electrification, for which the Ministry of Lands, Survey and Natural Resources will be the implementing agency. An international firm of consultants will undertake the TA and will provide 10 person-months of services. They will be engaged in accordance with the Bank's <i>Guidelines on the Use of Consultants</i> .



I. THE PROPOSAL

1. I submit for your approval the following Report and Recommendation on a proposed loan to the Kingdom of Tonga for the Second Power Development Project. The Report also describes proposed technical assistance for Institutional Development of the Tonga Electric Power Board (TEPB) and Rural Electrification, and if the proposed loan is approved by the Board, I, acting under the authority delegated to me by the Board, shall approve such technical assistance.

II. INTRODUCTION

2. The Bank in December 1994 approved a small-scale project preparatory technical assistance (TA) for the preparation of the proposed Second Power Development Project.¹ The consultants' draft final report was jointly reviewed by the Government and the Bank in March 1996. A final report, submitted by the consultants in April 1996, incorporated the comments of the Government, TEPB, and the Bank. A Fact-finding Mission was carried out in May 1996, and an Appraisal Mission² in July 1996. This Report is based on the consultants' report, a review of the progress of TEPB's Power Development Project³, visits to Project sites, discussions with Government agencies concerned, and consultations with external aid agencies and consumer groups involved in the power sector of Tonga.

III. BACKGROUND

3. The Kingdom of Tonga consists of 170 small Pacific islands with a total land area of about 750 square kilometers (km²), comprising an archipelago of four principal island groups: Tongatapu, Ha'apai, Vava'u, and the Niuas. It has a population of nearly 100,000, 65 percent of whom live on the main island of Tongatapu. Tonga is an open economy with a gross domestic product (GDP) per capita of about \$1,660. Agriculture is the main economic activity, which contributes about 40 percent of GDP, followed by the service sector (40 percent), small-scale industry and construction (about 5 percent), and other activities (15 percent). Remittances from overseas Tongans are the main source of foreign exchange earnings, which were estimated at over 50 percent of total foreign exchange receipts in 1995.

4. Over the past decade, per capita economic growth has averaged 1.8 percent per annum. The economy recorded a strong GDP growth of 5.2 percent in 1993/94. The growth is attributed mainly to successful introduction in the late 1980s of an agricultural export crop of squash targeted to the Japanese market in winter; growth of fish exports, particularly frozen tuna, to a cannery in American Samoa; the Government's expansionary fiscal policy in 1990/91; and liberalization of financial markets in 1993, which led to growth in credit, and increased imports and construction. Manufacturing and tourism industries, on the other hand, recorded only a minimal

¹ TA No. 2275-TON: *Second Power Development Study*, for \$100,000, approved on 29 December 1994.

² The Appraisal Mission comprised P.J. Hunt, Senior Project Implementation Officer/Mission Leader; T. Watanabe, Programs Officer; E. Araneta, Counsel; L. Bodda, Project Economist and B. Ivory, Consultant Financial Analyst. Subsequently, at the request of the Government, a Post-appraisal Mission was mounted in August to clarify the proposed loan covenants to the Executing Agency's Board of Directors.

³ Loan No. 1079-TON(SF): *Power Development Project*, for \$7.3 million, approved on 19 February 1991.

growth or decline. A report entitled "Tonga: Economic Performance and Selected Development Issues" (IN. 227.96) and its "Update" were circulated to the Board of Directors in October 1996.

5. Pending finalization of Tonga's Development Plan VII for 1996-2000, the Government has prioritized national objectives in the preparation of the Government budget. These objectives include (i) increased export earnings from goods and services by developing new overseas markets; (ii) increased economic growth and spread of growth to the outer islands; (iii) provision of infrastructure facilities (including power supply) for private sector growth, particularly for export-oriented industries; (iv) civil service rationalization; and (v) provision of employment opportunities across the nation for school leavers through expansion of the private sector, particularly industries engaged in export of goods and services.

A. The Energy Sector

1. Energy

a. Resources and Consumption

6. Tonga depends on imported petroleum for its commercial energy needs. Its economic growth will continue to depend on its ability to secure reasonably priced petroleum fuels, as no viable substitute fuel product is apparent in the medium term. The Government's plans in the energy sector for Development Plan VII are expected to continue the policies and objectives of Development Plan VI. The Government wishes to promote the least-cost supply of energy; and has policies seeking to promote the efficient utilization of energy and ensuring that timely investments are made in the most advantageous energy sources. The development of renewable energy sources to meet the growing demand for energy, or to replace petroleum-based sources of supply wherever technically and economically feasible will continue to form part of the energy plans. The Government, in general, considers that energy users should pay the full cost of the energy they consume; however, some subsidies exist in the power subsector and a policy of cross-subsidization is practiced. TEPB has a standardized tariff for electricity supply throughout the country; however, the cost of supply in the smaller islands is considerably higher than in Tongatapu.

7. In 1989, petroleum products accounted for around 11 percent of total imports by value; by 1994, this had increased to over 15 percent, representing an increase of some 9 percent per annum on a volume basis. The petroleum bill is a major concern of the Government, both in terms of its absolute size and in view of the volatility of the price of imported oil products, which continue to be sensitive to international political developments. With the continuing buoyant growth of the economy, the rate of increase in petroleum consumption is likely to exceed overall energy growth, so that the share of petroleum products consumption is expected to increase from the 39 percent in 1990 to 56 percent of the country's overall energy usage by the year 2000. Table 1 shows the gasoline and diesel oil imports in the past decade.

**Table 1: Gasoline and Diesel Oil Imports
(kiloliters)**

Product	1985	1990	1995	1985-1995 Growth Rate (%)
Gasoline	6,218	9,721	13,495	8.1
Diesel Oil	7,121	14,496	19,119	10.4

Source: National Reserve Bank of Tonga.

8. Automotive diesel oil (ADO) for electricity generation and gasoline dominate usage, but jet fuel is also an important item. ADO is primarily used in the transport, fishing, and electricity production sectors. Electricity generation consumes some 23 percent (by volume) of petroleum products imported. The consumption of ADO is projected to grow at approximately 7 percent per annum, as the demand for electricity increases in all the major islands, but this rate is lower than in the 1980s because a relatively high proportion of households are now connected to the grid.

9. Tonga's indigenous energy resources are very limited; there is no hydropower or geothermal potential. Although some indications of hydrocarbon resources have been found, exploration results to date have not been encouraging. Ocean-thermal and wind power are not expected to be significant energy sources in the near future. Wave energy feasibility was investigated in Tonga in the late 1980s under the auspices of the South Pacific Applied Geoscience Commission (SOPAC) and the Norwegian Government. It was envisaged that Norwegian financial assistance would be obtained for a scheme under development by a Norwegian private sector wave power plant manufacturer. However, the technology proved to be uneconomic with the pilot scheme in Norway producing only about 40 percent of the anticipated energy output. The proposal was abandoned after the installation was destroyed in a hurricane.

10. As is typical for most tropical climates, solar energy is a significant potential source for domestic and commercial usage with average daily insolation of 5.5 kilowatt-hours (kWh) per square millimeter (mm²). Agricultural uses of solar energy for such traditional purposes as crop drying and food preservation are prevalent and urban solar water heating systems are becoming more common, especially in the tourism industry. Solar electricity production by means of photovoltaic (PV) technology is part of the Government's rural development strategy. It is the most significant and practical source of energy for remote islands without access to diesel-based power distribution systems. It is generally used for the provision of essential services such as clinics, dispensaries, telecommunications, and for domestic lighting where only small loads are to be supplied.

11. The installation of PV units commenced in 1986 with the provision of 70 home lighting kits on the island of Taunga in the Vava'u group, and on Mango island in Ha'apai. The Government has requested both the French Government and the European Union (EU) assistance for further installation of PVs. The Government currently has plans to install 400 systems on 20 islands over a five-year period. Institutional and financial support services to manage this expanded program and these systems on a sustainable basis are not yet available.

Experience in other Pacific island countries indicates that strong institutional support is needed to provide long-term viability for such systems.

b. Energy Institutions

12. At present, the Ministry of Lands, Survey and Natural Resources (MLSNR) has overall responsibility for energy-related matters. An Energy Planning Unit (EPU) was established within MLSNR in 1983 and is primarily concerned with renewable energy, and energy conservation. A draft National Energy Policy Statement (NEPS) was prepared in 1995 by EPU with the assistance of the Forum Secretariat (Energy Division). This Policy Statement is presently under consideration by the Government and is expected to be approved in early 1997.

13. The NEPS recommends the strengthening of EPU as well as the establishment of an intersectoral consultative committee, the National Standing Committee on Energy, which would provide advice and recommendations to the Cabinet and directions to EPU on major energy sector issues and initiatives. EPU has not had sufficient manpower and financial resources to properly carry out its intended functions, nor to undertake its proposed expanded functions as defined by the NEPS. In view of the proposed large escalation in PV projects and, later, operation and maintenance (O&M) responsibilities, the Government has requested Bank technical assistance to EPU in this area to recommend suitable institutional and financial strengthening measures, including specialist staffing requirements, especially for rural and outer islands electrification programs.

2. Power Subsector

a. Overview

14. With no hydropower or other renewable energy resources available to Tonga, its electric power supply system is fully diesel-based, with the exception of the small number of outer island PV installations. TEPB, established under the Tonga Electric Power Board Act of 1949 (the Act), is a wholly Government-owned entity vested with the sole authority to generate and distribute electricity in the country. TEPB operates and maintains four separate power systems in the largest islands of the Kingdom: Tongatapu, 'Eua (an island close to Tongatapu), Ha'apai, and Vava'u.

15. Diesel generation stations on these islands, together with extensive distribution systems, now permit TEPB to provide power to about 94 percent of the total residential consumers on Tongatapu and about 83 percent of the country's residential consumers.

16. Power generation facilities were first established in Tongatapu in 1949, followed by those in Vava'u in 1970, Ha'apai in 1982, and 'Eua in 1983. Because of low system loads and lack of indigenous generation options, diesel-based thermal systems have been the only practical, technical, and economic means of power generation. The four systems operate 24 hours a day and, until 1992, were hampered by the poor condition and old age of many of the diesel units, together with lack of replacement parts and skilled maintenance staff. In recent years, however, TEPB has been upgrading and augmenting its diesel generating plant and distribution systems, as well as providing training for its technical staff. This has been accomplished with the assistance of the Bank's loan for the Power Development Project¹ and associated TA grants.

¹

Loan No. 1079-TON(SF).

b. Existing Power Facilities

17. The total available capacity of TEPB's diesel generating plant on the four islands presently amounts to 11,357 kilowatts (kW) to supply an aggregate, non-coincidental load of 5,987 kW, and producing a net (excluding own usage) energy generation of 30,763 kWh per annum. Sales of energy in the four systems in 1996 amounted to 27,780 kWh. A summary of the technical attributes of the four systems is provided in Table 2 and details on TEPB's installed diesel generating plant are in Appendix 1. The primary distribution system on Tongatapu consists of an 11-kilovolt (kV) system throughout the island, except for a small segment of the original 6.6-kV primary system in the western area. The primary distribution system voltage on the three other island systems of Vava'u, Ha'apai and 'Eua is 6.6 kV. The nominal consumer distribution supply voltage (low voltage) to all customers is at the regional three/single phase standard of 415/240V. In 1995, the Tongatapu system comprised 152 circuit-kilometers (km) of overhead lines, 19 circuit-km of underground cables, and 1.0 km of submarine cable (under the Nuku'alofa lagoon). The total circuit-km of low-voltage lines (three and single phase) on Tongatapu in 1995 was 448.

Table 2: TEPB Systems Details (1996)

Item	Tongatapu	Vava'u	Ha'apai	'Eua
Installed capacity (kW)	9,411	1,090	436	420
Firm capacity (kW) ^a	7,595	801	170	292
Peak demand (kW)	5,000	625	197	165
Net generation (MWh p.a.)	26,186	3,125	896	556
System losses (%)	10.1	19.5	17.6	17.6

^a Defined as equal to the system's installed capacity minus the size of the largest generating unit.

c. Power Systems Performance

18. The Tongatapu power system is the largest power system and accounts for about 86 percent of its total energy sales. In the 10 years since 1985, peak demand in the Tongatapu system has more than doubled, from 2,400 kW to 5,000 kW in 1995. Energy generation has risen commensurably, from 12,500 to 26,200 megawatt-hours (MWh) per annum, which represents an annual increase of 7.6 percent. No additional generating capacity was added until the Bank-assisted Power Development Project of 1991 provided two generators of 2,136 kW each, which were commissioned in 1995. This increased the nominal capacity in the Tongatapu Power Station from 5,854 kW, to 10,126 kW, which, when derated for age and tropical conditions, is equivalent to an available capacity of 9,411 kW.¹

19. System energy losses in Tongatapu, which are assessed to be mainly technical, have decreased from nearly 14 percent prior to 1985 to 10.1 percent in 1995, primarily because of investment in the losses reduction program financed under the first Bank power project. Although the nearly 4 percent reduction in losses is commendable, the residual level is still high for such small, compact systems and a further reduction to a target in the region of 7 percent should be planned for.

¹ A 945-kW, high-speed portable peaking unit was purchased in 1994 to cover delays in the installation of the 2,136-kW units.

20. Sectoral consumption is concentrated on the residential and commercial sectors while the productive sector represents a minor share of the total consumption. Table 3 shows the energy consumption sectoral breakdown.

Table 3: Power Subsectoral Consumption Breakdown

Sector	Energy Share (%)	No. Users Share (%)	Average Consumption (kWh)
Residential	46.8	79.0	1,109
Commercial	34.9	12.0	5,451
Industrial	3.5	1.0	6,572
Others	14.8	8.0	3,444
Total	100	100	1,872

21. For the three smaller systems combined, total energy generated has increased from 1,370 MWh to 4,577 MWh in the same ten-year period, an increase of 300 percent. However, these increases have been from a low base as two of the systems (Ha'apai and 'Eua) were only established in 1982/83. Generating capacity expansions in Vava'u and 'Eua were financed by the Bank under its 1991 loan, and that in Ha'apai, jointly by the Bank and Australian Agency for International Development (AusAID). Losses in the systems remain high – ranging from 17 to 19 percent – because of the poor physical state of the systems and lack of rehabilitation. Historical performance statistics covering energy generated and sent out, peak demands, and load factors for TEPB's systems over the past ten years are shown in Appendix 2. For the larger Tongatapu and Vava'u systems, the statistics indicate declining demand and consumption growth rates in later years, which is typical of maturing systems.

d. Demand Projections

22. Under the project preparatory TA (TA No. 2275-TON) for the proposed Project, the consultants developed the power demand forecast for the four TEPB systems for a ten-year planning period (1996 - 2005). The consultants reviewed the systems' actual performance statistics over the past five years, the 1990 demand projections developed under the first preparatory TA undertaken in 1990, and expected commercial, industrial, and other developments. For Tongatapu, it is seen that demands have increased over the past five years at an average annual growth rate of about 5.3 percent. In Vava'u, average growth rates over the same period have been about 3.8 percent.

23. The new demand projections for 1995-2001 have taken into account the high electrification ratios already achieved in the Tongatapu and Vava'u systems. For Tongatapu, it is projected that the present demand growth rate of about 5 percent will continue until 1998, and then grow at lower rates in the region of 4 and 3 percent, averaging 4.6 percent over 1995-2001. For Vava'u, a large 1995 - 1996 addition to the distribution system in the western part of the island, plus additional tourism facilities, has led to a significant increase in consumption in early 1996; the system is expected to have an average growth in demand of 3.9 percent per annum for

1995-2001. Only modest demand growths are expected in the Ha'apai and 'Eua systems. Details of demand forecasts for the four systems are shown in Appendix 3 and summarized in Table 4.

**Table 4: TEPB Systems Demand Projections
(1995 - 2001)**

Item	Tongatapu	Vava'u	Ha'apai	'Eua
Peak Demand 1995 (kW)	5,012	625	197	172
Peak Demand 2001 (kW)	6,549	786	253	199
Demand Average Growth (%)	4.6	3.9	4.3	2.5
Energy Sales 1995 (MWh)	22,305	2,253	651	402
Energy Sales 2001 (MWh)	30,104	3,258	842	533
Sales Average Growth (%)	5.1	6.3	4.4	4.8

e. Tariffs

24. TEPB has the authority to set its own tariffs. It has generally followed full cost recovery pricing policies, which have been instrumental in enabling it to establish and maintain a sound financial position. In September 1985, a uniform, flat rate tariff and minimum monthly charge was adopted for all four systems. A fuel surcharge mechanism was instituted to allow prompt response to significant fluctuations in fuel costs. The basic rate remained unchanged at T\$0.2385 per kWh until July 1993. Surcharges varied from T\$0.0147 per kWh in May 1990, to T\$0.1252 per kWh in January 1991. At about US\$0.25 per kWh in 1992, the average price of power was high by regional standards. The tariff structure is simple and, because TEPB uses a single type of generation (diesel), it is simple to administer for all consumer groups. Table 5 summarizes recent tariff history. The rates per kilowatt-hour and minima are for Tongatapu only; the rate for outer branches is about 2 percent higher to cover additional fuel transport costs. The average yield is for all systems.

Table 5: TEPB Tariff History

FY	Unit Rate (T\$/kWh)	Minimum Charge (T\$/kWh)	Average Yield (T\$/kWh Sold)
1990	0.2532	3.01	0.2538
1992	0.3209	3.84	0.3345
1994	0.3600	4.32	0.3835
1995	0.3600	4.32	0.3790
1996	0.3600	4.32	0.3640 ^a

^a Estimated.

25. In view of TEPB's planned extensive investment program, lack of recent asset revaluations, and the need to establish its long-term financial viability, the Bank provided in 1992 TA No. 1479-TON¹ in conjunction with the first Power Development Project, to conduct, inter alia,

¹

TA No. 1479-TON: *TEP Institutional and Financial Development Study*, for \$365,000 approved on 19 February 1991.

a tariff study. The consultants' November 1992 Tariff Study Report contained long-run marginal cost (LRMC) calculations and indicated probable future revenue requirements and resulting indicative average revenue yield per kilowatt-hour. It stated that the demand profile (largely domestic and small commercial-industrial) and the nature of supply (uniformly diesel-thermal) did not warrant a change from the current simple uniform tariff structure, that is, introduction of tariff complexity to, for example, distinguish between end users or time of use was not justified. The weighed average LRMC tariff was found to be T\$0.2225 per kWh, or T\$0.35 including duties and taxes on fuel. This was only slightly greater than the then total tariff of T\$0.3427 per kWh.

26. The consultants considered that no financial or other advantage would be gained in charging a higher rate in the outer islands because of the overwhelming proportion of national electrical energy consumed in Tongatapu — 86 percent, which was expected to increase to 90 percent. In regard to the fuel cost surcharge, because only one major adjustment was needed in the past ten years, it was recommended that the surcharge be incorporated in the base tariff. The most salient finding of the consultants, however, was in relation to the revenue requirements to meet Bank covenants, especially the 8 percent rate of return (ROR) covenant, and other obligations. It was estimated that, based on the then estimated financial projections, an average revenue yield required in FY1993 was T\$0.3885 per kWh. In response to this need, TEPB raised its tariff in July 1993 to a total charge of T\$0.36 per kWh. The fuel cost surcharge was incorporated in the base tariff in March 1994. TEPB's tariff history is shown in Appendix 4, page 1. The consultants also indicated that their review of the economic costs — LRMC — of supplying electricity showed that the rates charged by TEPB are of the right order to convey fair economic price signals to consumers. However, the consultants provided a caveat in that their review had been based on, as then, uncertain development program costs that would only be firmly ascertained after the bidding had been completed for the Bank-financed Power Development Project.

27. At the time of the July 1993 tariff increase, it was recognized that further adjustment may be necessary within six months, depending on oil price trends and TEPB's financial results. During the following period, world oil prices dropped sharply and TEPB comfortably met the ROR and debt-service ratio (DSR) covenants in 1993 to 1995 without further rate increases. However, the Mission's estimates indicate that a small tariff increase may be necessary in the near future to maintain compliance with the ROR covenant. To a large extent, this reflects the need to catch up on local inflation, for which the tariff has not been adjusted. This deficiency is illustrated in Table 6 and in Appendix 4, page 2, which shows the decreasing value of the 1985 tariff in terms of 1995 prices. The Mission has therefore provided for a review of the tariff under the proposed TEPB institutional development TA.

**Table 6: Average Tariff in Constant 1996 Prices
(T\$/kWh)**

1990	1991	1992	1993	1994	1995	1996
0.344	0.396	0.396	0.416	0.422	0.396	0.364

B. Government Policies and Plans

28. With limited options available to it for power generation, Government policies in the subsector have aimed at obtaining least-cost solutions to electricity production and distribution. Additionally, the Government has targeted increasing efficiency in the subsector with emphasis on

reducing losses and increasing the availability and efficiency of generating plants. Appropriate tariffs and cost recovery issues are also an area where the Government issues policy guidelines. The draft NEPS (see par. 12) recommended the formation of a National Committee on Energy comprising a cross section of community energy users. The Committee would coordinate sector development, formulate policy, and ensure that development is consistent with policy objectives.

29. Two development plans for the power subsector have been drawn up in recent years, both with the assistance of Bank TAs. The first was prepared in 1990 under TA No. 1250-TON: Power System Development Study¹, which reviewed the requirements of TEPB for expansion and rehabilitation of its generation and distribution facilities. The more urgent plant and system development needs were financed under the Bank's 1991 Loan No. 1079-TON(SF): Power Development Project. The recently completed project preparatory TA No. 2275-TON: Second Power Development Study, which commenced in 1995, has updated TEPB's medium- to long-term development plans and recommended consolidation with system improvements provided under the 1991 Bank-assisted project loan. The main feature of the revised development plan is an emphasis on rehabilitation, especially of the Tongatapu generation facilities, and of all four distribution systems, where energy losses require further reduction (in Tongatapu) or remain high (in the outer island systems). Further, the cited TA studies have established that oil-based power generation provides the least-cost solution to electricity production.

C. External Assistance to the Subsector

30. The Bank has provided the majority of assistance to the power subsector in the past six years. This has comprised three TAs (two project preparatory, and one advisory) and a \$7.3 million loan for the Power Development Project. Complementary assistance has been provided by Australia, through AusAID, which has concentrated on the power generation additions for Ha'apai. The Government is also seeking assistance from the French Government and EU for the commencement of a substantial outer islands PV program to provide electricity to remote communities. The Forum Secretariat has provided assistance to develop an energy policy statement. The United Nations Development Programme (UNDP) assistance has also been utilized in 1994, in association with other Pacific developing countries, to prepare designs for a demand management program for TEPB. The details of all external assistance to Tonga are in Appendix 5.

31. Coordination of external assistance in the subsector is needed in view of the interest of various multilateral and bilateral agencies in providing further assistance for outer islands electrification. Although uneconomic in terms of Bank criteria, electrification of the Niua and Ha'apai outer islands, both of which were studied under the Bank's project preparatory TA, may interest other aid agencies, given the socioeconomic needs of these two island groups. Additionally, some aid agencies may finance further PV systems in the remoter parts of these and other areas of Tonga. To coordinate activities and strategies, an aid agencies' coordination meeting was held during Appraisal. The scope of the proposed Bank project, proposed loan covenants, the TA for rural electrification, and cost recovery and institutional arrangements for sustainability of outer islands electrification systems were discussed. It was agreed that continuing donor coordination, especially in regard to rural/outer islands electrification, cost recovery, and corporatization of TEPB, should be maintained to ensure complementarity and consistency in policies among the aid agencies. The proposed associated advisory TA would provide the basis

¹

TA No. 1250-TON: *Power System Development Study*, for \$100,000 approved on 19 December 1989.

for continuing dialogue, particularly in regard to institutional structures and financing arrangements for the rural electrification program.

D. Lessons Learned

32. Tonga has had a good record in project implementation. Of the 13 loans approved by the Bank, 7 have been postevaluated. Of these, six have been classified as generally successful and one partly successful. In the power subsector, the Bank has provided only one loan for the Power Development Project, which was approved in 1991, for an amount of \$7.3 million. This provided for generation and distribution facilities in the four TEPB island power systems. Implementation of the Project took six years as against three years projected at appraisal. The reasons for the longer than anticipated implementation period were an overly optimistic implementation schedule, and unsolicited offers for alternative power generation solutions (such as reconditioned diesel plants and waste-burning thermal schemes, etc.), which prompted the Government to hold back on project implementation at critical stages. Problems in contract packaging and cost overrun caused further delays. The Project has been substantially completed and will be fully operational by the end of 1996. Lessons learned from other postevaluated power projects in the Pacific include the following: (i) executing agencies should be strengthened to improve their project design capability, (ii) definite programs of tariff adjustments should be followed, (iii) there should be a consistency in financial covenants among aid agencies, and (iv) the limitations of project design at appraisal stage should be clearly identified as project risks. The proposed Project has been designed to address the above concerns through the provision of (i) design and maintenance training to TEPB staff by Bank TA, (ii) tariff review assistance and adjustment covenants, (iii) coordination on institutional and policy aspects with other aid agencies, and (iv) restricting the design of the Project to technologies familiar to the executing agency.

E. The Bank's Sectoral Strategy

33. The Bank's "Strategy Paper for the Pacific", issued in September 1995, defines the overall operational strategy for the Pacific islands developing member countries. It outlines the general strategy for the Pacific region as well as the specific strategies for individual countries. The paper identified three key areas to justify Bank intervention in a particular sector: (i) economic growth, (ii) capacity building and policy reform, and (iii) regional cooperation.

34. For Tonga, the Bank strategy emphasizes assistance for public sector reform — especially in capacity building, and support for infrastructure development to facilitate private sector development — and agricultural diversification. The Bank in recent years has supported infrastructure development in Tonga through the Fourth Multiproject,¹ the first Power Development Project, and the Transport Infrastructure Project.² The Fisheries Development Project³ and Outer Islands Agriculture Development Project⁴ will assist further development of the agriculture and fisheries sector, which has demonstrated strength in capturing overseas niche markets since the late 1980s. In the area of public utilities, the Bank will undertake policy dialogue to introduce institutional reform by means of corporatization and the resultant

¹ Loan No. 927-TON(SF): *Fourth Multiproject*, for \$3.3 million, approved on 29 November 1988. This Project included construction of an agricultural produce market and roads, and expansion of the Small Industries Center.

² Loan No. 1303-TON (SF): *Transport Infrastructure*, for \$10 million, approved on 28 June 1994.

³ Loan No. 1030-TON (SF): *Fisheries Development*, for \$2.4 million, approved on 6 September 1990.

⁴ Loan No. 1412-TON (SF): *Outer Islands Agriculture Development Project*, for \$3.635 million, approved on 12 December 1995.

lessening of Government controls in day-to-day management of the utility as well as improvement of financial management, cost efficiency, and the implementation of cost recovery strategies.

F. Policy Dialogue

35. The Bank commenced policy dialogue with the Government in the power subsector in 1990 during the preparation and appraisal of the first Power Development Project. By way of advisory TA, and under the provisions of the Loan Agreement, the Bank has been actively involved in policy dialogue in three key areas of the power subsector.

1. Institutional Reform

36. Institutional reform of TEPB has been the focus of the Bank's policy dialogue since 1991. The TEPB Act, while providing the legal framework under which TEPB operates, did not provide sufficiently clear corporate objectives, financial and operational performance standards, and organizational structure. Accordingly, institutional reform and strengthening, including initial steps toward corporatization, and strengthening of the financial capability of TEPB were studied under the advisory TA (TA No. 1479-TON: TEPB Institutional and Financial Development) approved in 1991. Specifically, the TA provided for a review of the TEPB Act, the development of corporate and financial objectives, the definition of an appropriate organizational structure and management responsibilities, the review of continuing contracting and retailing operations, and the development and installation of computerized accounting and management information systems (MISs).

37. In addition, it assisted in the amendment of the existing TEPB Act to make the utility a more commercially oriented corporate entity. The TA study also recommended the adoption of more appropriate institutional structure, including the change of TEPB to a Commission, changes in its Board policy objectives, and management titles, responsibilities, and method of appointment. These changes have been included in the amended TEPB Act, which is currently before the Cabinet for consideration and is expected to be approved by Parliament by December 1997. The development of staff skills has also been undertaken through training provided under the first project. The focus of current institutional strengthening measures is on improving the organization's performance indicators such as sales per employee, overhead and administrative cost per kilowatt-hour (kWh) and commercial responsibility of the utility, its Board, and Management.

2. Least-cost Development

38. The development of least-cost, long-term power system investment programs has been supported by the Bank under the two TA projects. The Government's policies for the sector is to ensure that least-cost development is undertaken by the power utility, and that plant and system efficiency is maintained to provide the lowest cost of operation and system reliability. Generation options such as wave power, and biomass- and waste-fueled thermal generation schemes have been studied but rejected on the basis of their poor technical and economic feasibility. Least-cost power generation expansion, based on the existing diesel thermal technology as established under the various Bank-financed TA studies, and distribution rehabilitation programs for all four of TEPB's power systems are being implemented under the Bank's first Power Development Project. These programs are proposed to be continued under the subject Project. TEPB has been assisted in the production of these development programs by two project preparatory TAs. For smaller systems and the outer islands, the Government is

encouraging the use of PV systems, where economical, and bilateral and multilateral assistance is being utilized to expand these installations. The proposed associated advisory TA will recommend appropriate institutional and financial structures to ensure the sustainable financial and technical viability of these systems and also to increase the utility's capability and facilities for planning of its future development (see paras. 84 to 87).

3. Financial Viability/Cost Recovery

39. The financial viability of TEPB has been an important policy issue for the Bank, particularly in regard to appropriate cost recovery targets, the provision of sufficient funds for sustainability of assets, and the establishment of utility performance targets. Following the tariff study provided in the 1991 advisory TA, TEPB adjusted tariff levels to meet financial targets. The aims of the Bank in this area were to guarantee the efficient operation of the utility by way of ensuring that sufficient finance was available for O&M. To achieve this, the LRMCs of supply were investigated under the TA and self-financing targets were developed to enhance the affordability of TEPB's long-term investment program. Additional assistance has been provided in the financial and accounting areas by the installation of computerized systems under the Bank's 1991 advisory TA and would be continued under the proposed Project and the associated TA.

40. By facilitating TEPB's adherence to tariffs at or about the LRMCs of supply, the utility has ensured that the wastage of electric energy has been minimized. Other demand management measures have nevertheless been investigated, under multilateral donor assistance, and programs have been initiated to further reduce demand. Even without such facilities, however, TEPB's appropriate tariffs have enabled the country to limit power usage such that it has the lowest average energy consumption per consumer among the Pacific DMCs.

IV. THE PROJECT

A. Rationale

41. The Bank's involvement in the proposed Project derives its rationale from the Government's and the Bank's strategy to develop infrastructure facilities that support economic growth and private sector expansion. The Project is intended to meet the steady growth in demand for power in the operation of physical infrastructure developed in recent years, agro-industry, tourism, and commercial and other service industries. Without the Project, growth in these sectors would be constrained. Bank intervention is further justified by the envisaged increase in power supply security, which the new and rehabilitated plant will provide. The Project will also contribute to the Government's energy conservation measures, and enhance the power utility's efficiency and cost-effectiveness by improving its performance indicators and reducing distribution energy losses. Further institutional and financial strengthening of TEPB will be achieved under the proposed associated TA.

B. Objectives and Scope

42. The objectives of the Project are to improve the capacity and efficiency of the power utility in Tonga to provide reliable electric power supply to the major populated areas. The Project will also assist in reducing energy losses in the four distribution systems by increasing line capacities, rearranging circuits, installing more and larger transformers, and providing compensating devices.

43. The Project comprises the rehabilitation of generating plant and power station facilities in Tongatapu, installation of a new generating plant in Vava'u to permit the retirement of the old and inefficient plant; and replacing switchgear, increasing the power distribution capacity, and generally improving the reliability of the distribution systems. The Project comprises the following major components. Detailed descriptions of the components are in Appendix 6:

(i) Power Generation

- (a) Part A - Generation plant rehabilitation. Rehabilitation of the older section of the Popua Power Station on Tongatapu, rehabilitation of station services facilities, and power generating unit auxiliaries and controls, including refurbishment of the four old diesel sets (units 1 & 2 of 1,200 kW; units 3 & 4 of 1,730 kW) including a major overhaul of three of the four generating units (units 2, 3 & 4); and
- (b) Part B - Generation plant expansion. Installation of two new 300-kW diesel generating units, station services facilities, and auxiliary systems in the Taumu'aloto Power Station in Vava'u.

(ii) Power Distribution

- (a) Part C - Distribution systems upgrading. Completion of Phase I of TEPB's losses reduction program in the four TEPB systems of Tongatapu, Vava'u, Ha'apai, and 'Eua; and implementation of Phase II of the Program; and
- (b) Part D - Distribution infrastructure improvement. Implementation of the distribution systems' security improvement measures; and improvements to distribution systems' efficiency and control, and upgrading of distribution infrastructure facilities.

(iii) Others

- (a) Part E - Equipment and materials. Equipment and materials for distribution maintenance and computerized distribution systems geographical data base and assets registry; and
- (b) Part F - Consulting services. International consulting services (24 person-months) in the fields of diesel generation, power distribution, and associated training.

C. Technical Justification

44. The electric power supply systems in Tongatapu and Vava'u will shortly be under stress with demand rising and the older generating plant approaching the end of its economic life. Load shedding (blackouts) will occur increasingly without plant replacement or rehabilitation, thus presenting powerful disincentives to potential commercial and industrial entrepreneurs to invest in Tonga. In Tongatapu, with peak demand presently over 5,000 kW, diesel plant with a generating capacity of about 6,800 kW has been in service for 15 to 25 years, providing about 4,980 kW (i.e. 73 percent). Peak demand in the system is projected to increase to over 6,500 kW by 2001, which is approaching the firm capacity of the system. With little surplus capacity at its disposal, the system relies heavily on this old plant. The two options are either to replace the old plant or

to rehabilitate it. The least-cost solution, which has been shown to be technically feasible, is rehabilitation. In Vava'u, where the present peak demand is 747 kW, the system is 35 years old and provides 600 kW of its 800 kW firm capacity. It must be replaced by new plant as rehabilitation is not technically feasible.

45. The consultants have reviewed the demand forecasts for the four TEPB systems and produced least-cost generation development programs to meet the expected loads. In the Tongatapu system, no new generating plant will be required in the immediate future in view of TEPB's plans to rehabilitate old plants and to operate the system on a one-unit-capacity margin. For Vava'u, additional generating capacity amounting to 600 kW (two 300-kW units) is required for installation in the new Taumu'aloto Power Station (constructed under the Power Development Project) to replace units to be retired in the old Neiafu power station.

46. Under the Power Development Project, an amount of \$1.1 million was included to cover financing for the first phase of a distribution system losses reduction program, together with some provision for distribution expansion. Because of cost overruns on the generation component of the Project, only some \$456,000 has been expended on the Project's distribution component. Consequently, the proposed Project provides for the completion of the first phase of the losses program and also for the implementation of the second and final phase. Additional components are also proposed to provide increased security and operations efficiency, and to improve maintenance facilities for the distribution systems.

D. Cost Estimates

47. The total cost of the Project is estimated at \$7.1 million equivalent, of which \$4.9 million (70 percent) is the foreign exchange cost and \$2.2 million equivalent (30 percent) the local currency cost. The cost estimates are based on 1996 prices and incorporate provisions for physical contingencies and price escalation, as well as loan service charges during construction. The Project cost estimates are summarized in Table 7 and details are shown in Appendix 7.

Table 7: Project Cost Estimates Summary
(\$ '000)

Item	Foreign	Local Exchange	Total Currency	Cost
A. Base Cost				
1. Part A: Generation Plant Rehabilitation	1,510	725	2,235	
2. Part B: Generation Plant Expansion	445	180	625	
3. Part C: Distribution Systems Upgrading	870	470	1,340	
4. Part D: Distribution Infrastructure Improvement	120	125	245	
5. Part E: Equipment and Materials	470	--	470	
6. Part F: Consulting Services	415	185	600	
Subtotal	3,830	1,685	5,515	
B. Contingencies	920	515	1,435	
C. Loan Service Charges	150	--	150	
Total	4,900	2,200	7,100	

E. Financing Plan

48. It is proposed that the Bank provide a loan of \$4.9 million equivalent to finance the Project's foreign exchange costs. TEPB will finance all of the local currency costs of \$2.2 million equivalent from its own resources. Table 8 indicates the proposed Project financing plan. The loan will be from the Bank's Special Funds resources with a maturity period of 40 years, including a grace period of 10 years, and will carry a service charge of 1 percent per annum. The Borrower will be the Kingdom of Tonga and the proceeds of the loan will be relented to TEPB under a subsidiary loan agreement. The terms of the relending will be at least the Bank's US dollar ordinary capital resources rate, currently at 6.82 percent per annum, with a maturity of 20 years including a grace period of 5 years. The Government will bear the foreign exchange risk on the Bank loan.

Table 8: Financing Plan
(\$ million)

Source	Foreign Exchange	Local Currency	Total Cost	Percentage of Total
Bank	4.9	--	4.9	70
TEPB	--	2.2	2.2	30
Total	4.9	2.2	7.1	100

F. Implementation Arrangements

1. Project Management

49. The Tonga Electric Power Board will be the Executing Agency for the Project. The implementation arrangements and the Project Office will be the same as for the ongoing Power Development Project. Assistance to TEPB in project design, procurement, and construction will be provided by consultants. TEPB has sufficient expertise in a large range of project implementation and supervision tasks required for the Project, a substantial part of which comprises procurement and installation of power distribution equipment. Consulting services are therefore envisaged to be restricted to Project design (including design studies as necessary), assistance in procurement, and supervision of the construction/rehabilitation of generation facilities.

50. To facilitate monitoring and administration of the Project, TEPB will submit quarterly Project progress reports. The reports will outline the progress of all major activities including general progress, adherence to the implementation schedule, problem areas, cost control, and any planned deviation from the Project's design or implementation methods. It will also discuss the major problems encountered and actions taken or proposed.

2. Implementation Schedule

51. The Project will be implemented over a period of approximately five years from Bank approval of the loan. Commencement of implementation of various Project components has been phased to prevent overloading of the staff of the TEPB. The task requiring the longest to

complete is the distribution systems upgrade, because of the extensive area to be covered, which will extend over the entire implementation period. Details of the implementation schedule are shown in Appendix 8.

3. Midterm Review

52. A midterm review of the Project will be carried out halfway through the implementation period, or at a time to be mutually agreed upon between the Government and the Bank. During the review, aspects of the Project's implementation progress will be examined such as, costs, contract progress, procurement issues, and consultants' performance. The need for modifications to the Project's scope, funding, and other implementation arrangements will be assessed. The financial and managerial status of TEPB, including its tariff requirements, and the progress of the associated advisory TA will also be thoroughly studied during the review.

4. Procurement

53. Procurement will be carried out in accordance with the Bank's *Guidelines for Procurement*. The largest equipment contract is for the Tongatapu Generating Plant Refurbishment under Part A of the Project. It will be a turnkey contract including design and civil works and will be awarded under international competitive bidding (ICB) procedures. Distribution material, equipment, control systems, tools, etc. under Parts C and D of the Project will be procured under international shopping (IS) procedures. Where necessary (for example, for the distribution control system), small local contracts financed by TEPB from local funds will be awarded on the basis of the Government's local competitive bidding procedures or on a direct purchase basis.

54. For the Vava'u new diesel plant under Part B of the Project, the two 300- kW diesel generation units valued at \$0.625 million will be procured by means of direct purchase to obtain plant and equipment identical to those procured under the first Power Development Project funded by the Bank. This is in the interest of economy and efficiency, given the remote location of the site and the high cost associated with procuring machinery different from the two units procured under Bank ICB procedures under the first Power Development Project. The proposed Project will thus be provided with 340-kW generators. Details on the contract packages and procurement methods are in Appendix 9.

5. Consulting Services

55. An international firm of consultants required to assist TEPB implement the Project will be engaged by TEPB under the Bank's *Guidelines on the Use of Consultants*. The consulting services are needed to undertake some specialist tasks for which TEPB does not have the requisite expertise, such as the design, specification, and procurement of the generation equipment. Some assistance may also be necessary in the construction and commissioning of these facilities and for this, the consultants will be retained on an as-needed basis. For the transmission and distribution components, TEPB has the necessary expertise required for design, procurement, and installation work. The consultants, however, will undertake studies to optimize the distribution security improvements and estimate losses reduction measures. Outline terms of reference for the consulting services, estimated at 18 person-months for international consultants and 6 person-months for domestic consultants, are given in Appendix 10.

6. Imprest Account

56. To avoid possible delays in the processing of withdrawals from the loan during Project implementation, an imprest account will be set up in accordance with the Bank's *Guidelines on Imprest Fund and Statement of Expenditures Procedures*, with an initial deposit of about \$300,000, to meet about six months' disbursements on distribution materials.

7. Benefit Monitoring and Evaluation

57. A project benefit monitoring and evaluation system (BME) for the Project will be established by TEPB with assistance by the Project consultants in accordance with the Bank's *Handbook on Benefit Monitoring and Evaluation*. The baseline data will be derived mainly from the economic and benefit-related information collected during the feasibility studies. BME will focus on areas such as distribution losses reduction, system load growth, consumer energy consumption changes, load shedding incidence, and quality of supply. The financial performance of TEPB will also be monitored and provision made for performance indicators, including average tariffs, to be computed. Appendix 11 indicates typical indicators and performance measures that will be considered by TEPB and the consultants during formulation of the BME system. As is typical for most power utilities (where metering and recording of performance data are both convenient and accurate), much of the information is presently available but needs to be incorporated into an MIS. Reporting systems also need to be developed for presenting the indicators and performance measures to TEPB's management and the Board.

G. The Executing Agency

1. Legal Framework and Basic Purpose

58. TEPB is a statutory authority constituted under the Tonga Electric Power Board Act 1949 and amendments. Under it, only the Board and licensees of the Board may generate and distribute electric power. The Act provides the legal framework governing TEPB's management and operations and, inter alia, empowers it to make bylaws to regulate the construction, use, and management of electrical works and installations. The Act provides for TEPB to be administered by a Board of Directors not fewer than nine in number and a Manager who attends Board meetings.

59. TEPB presently has a Board of ten members who meet once a month. The members include three Cabinet Ministers, with the Minister of Health serving as Chairman. TEPB's Chairman is appointed by the Privy Council,¹ and the members are appointed by the Chairman. The Act stipulates that the Board should comprise two Cabinet Ministers, one of whom is the Minister for Police who fills the second position. A third Cabinet Minister, the Minister for Works, fills one position out of the four on the Board for consumers representatives. Other members represent industrial consumers and business interests. The General Manager is represented as an exofficio member. A list of Board members is given in Appendix 12.

60. The consultant appointed to carry out TA 1479-TON, Institutional and Financial Development of TEPB, reviewed the Act in 1992-1993 and recommended a replacement. The Act was redrafted with legal assistance provided under the Bank's TA. Among others, the new Act

¹ The Privy Council comprises His Majesty the King as Chairman, plus all members of the Cabinet.

seeks to define the purpose of TEPB,¹ places increased emphasis on the need for TEPB to operate on a fully commercial basis bearing its full measure of costs, to price its services at a level that is able to provide an appropriate standard of service to customers, and earn an adequate return on funds invested. The Bill is currently with the Cabinet for consideration/approval and is expected to be approved by December 1997.

61. The commercial emphasis in the new TEPB Act will be reinforced by the Government's planned reformed framework for the operation of its enterprises. Among the new requirements proposed for the enterprises in this framework is a payment of regular dividends from after-tax profits.

2. Organization and Management

62. TEPB is organized according to four functions, each headed by a senior executive: Chief Engineer Generation, Chief Engineer Transmission and Distribution, Chief Accountant, and Administration Manager.² All report directly to the General Manager. Three Branch Managers, who also report to the General Manager, supervise all day-to-day activities related to operating and administering the three outlying island systems. An Internal Auditor was appointed in April 1996 as recommended under TA No. 1479-TON. The consultant for TA No. 1479-TON reviewed TEPB's appliance retailing operation and recommended that it be dropped. This was implemented in 1993.

63. New management arrangements, approved by the Board following the recommendations of the TA No. 1479-TON study, increase the accountability of management by setting out responsibility for budget preparation and, after approval by the Board of Directors, granting the chief executive explicit authority for approving budgeted expenditure. The organization structure is appropriate to the size and scale of the utility and its enhanced commercial orientation. TEPB's organization chart is in Appendix 13.

64. As of 30 June 1996, TEPB had 350 employees and 16,800 active customers, giving a ratio of 48 customers per employee. Despite an increase of 36 percent in the number of customers since FY1990, the efficiency has not improved. As a result, substantial pay increases made in FY1994 (partly to offset the relative attractiveness of emigration for skilled staff) were a major contributor to a 35 percent rise in nonfuel operating costs per kilowatt-hour sold in FY1995.

65. A training officer is employed and regular training sessions (both technical and nontechnical) are held. The training program for FY1997 has components covering all the main activities and includes management development workshops and skills training.³ Department Heads are responsible for identifying training needs; for external courses, they must submit estimates of costs and benefits. TEPB sponsors traineeships for professional and subprofessional courses in engineering, accountancy and computer science in universities and colleges in Australia, Fiji and New Zealand.

¹ To operate, maintain, and develop the electricity generation system in an efficient and profitable manner to the best interest of the Kingdom.

² TEPB has not employed expatriate managers since 1991.

³ External tutors are employed for user training courses in computer applications such as word processors and spreadsheets.

3. Accounting, Audit, and Financial Control

66. Under TA No. 1479-TON, TEPB's partly computerized billing and financial accounting systems, which had proven inadequate, were replaced with a modern proprietary suite of billing and financial accounting programs and new equipment. The vendors of the new systems have provided basic staff training in the O&M of the computing systems and continue to provide good support. System enhancements have been made as required, and the performance of the system now meets the utility's needs. Extension of computerized accounting to the island systems is to be investigated under the proposed TA.

67. The TA also introduced modern budgetary planning and control procedures and a comprehensive MIS. Budget planning by responsibility center is detailed and includes quantitative as well as financial data. Budgets for both capital works and operating expenditure are approved by the Board. Actual results are compared against monthly and year-to-date budgets and variance is reported. At the time MIS was introduced, it was necessary, in the absence of an adequate report writing facility, to use spreadsheets to produce the monthly MIS reports. TEPB staff have experienced difficulty in maintaining the accuracy of the MIS output procedures because of the detailed knowledge this required. The existing report the generation procedures are expected to be replaced under the proposed TA with a new spreadsheet report writer to be procured.

68. The annual financial statements of TEPB are audited by the Auditor General of Tonga. The time to produce final accounts and to complete the audit has been sharply reduced by a combination of staff effort and effective use of the new procedures.¹ However, there are shortcomings in the content and format of the financial statements which are to be addressed in the proposed TA to bring future published statements in line with generally accepted international practice. In particular, greater disclosure and explanation of movements in reserves and of unusual items are required, the policies for treatment of major plant overhaul costs and bad debts need to be reconsidered, and decision guidelines for determining materiality are to be provided.

69. During appraisal of the first Power Development Project, the Government and TEPB agreed inter alia that TEPB's accounts would be audited "in accordance with sound auditing standards by auditors acceptable to the Bank." Since no international auditing firm practices in Tonga, the Bank accepted the existing audit arrangements. The Appraisal Mission's examination of TEPB's financial statements for FY1990 to FY1995 indicates that the audits may not meet the Bank's or internationally accepted standards. The matter will be examined further in the proposed TA and recommendations made to improve the standard of audit.

4. Financial Performance

70. TEPB's recent performance has been influenced by heavy investment in the new generating plant, and steady sales growth since 1990 at about 7.5 percent per annum. Falling fuel prices and improved efficiencies since FY1991 have resulted in a slight decline in fuel cost per unit (kWh) of net energy generated. Total nonfuel operating costs per kWh have risen 30 percent since FY1990, largely influenced by increases in staff numbers and wages (see par. 62). Energy generation and sales statistics indicate that investments in loss reduction under Loan No. 1079-TON(SF) are producing lower transmission and distribution losses.

¹

The final statements for FY1996 are planned to be available within five months of year end.

71. Since 1990, a sales growth of 40 percent has resulted mainly from a 36 percent increase in the number of consumers. Per capita consumption has increased by only about 3 percent. During the same period, employee productivity has remained in the range 48-50 consumers per employee. Comparing TEPB with similar small island power utilities indicates that sales per employee are in the lower part (75 MWh) of the range of 60 MWh to 162 MWh. A substantial adjustment in salaries and wages was made in FY1994. Tariff rates were increased slightly in FYs 1992, 1993, and 1994, but the cumulative rate of increase is lower than local inflation, thereby reflecting a decrease in real terms.

72. Under Bank loan covenants, TEPB is obliged to achieve a DSR of greater than 1.3 times and a ROR on assets of 8 percent. Profitability¹ rose from 3.5 percent on average net fixed assets in service in FY1991 and FY1992 to a peak of 21.5 percent in FY1994; it subsequently declined to 8.8 percent in FY1995 largely because of the debt servicing for Loan No. 1079-TON(SF) facilities. It is expected to fall below the covenanted 8 percent for FY1996 for lack of recent tariff increases to compensate for inflation and administration and general cost increases, which exceeded inflation. TEPB's detailed financial statements are shown in Appendix 14 and a summary of its financial and operating performance is shown in Table 9.

**Table 9: Summary of Past Financial Performance
(T\$'000)**

Year ending 30 June	1991	1992	1993	1994	1995
Revenue	6,527	7,146	8,109	8,952	9,707
Operating Profit	50	178	558	1,502	789
Net Profit	90	113	295	744	472
Fixed Assets	4,641	5,010	6,114	6,174	12,536
Noncash Working Capital	710	309	500	1,020	1,483
Cash & Investments	1,108	1,188	906	1,042	829
Total Capital Employed	6,459	6,507	7,520	8,236	14,848
Return on Average Net Fixed Assets	2.5%	4.8%	10.1%	21.6%	8.8%
Debt-service Cover	1.9 times	2.2 times	1.6 times	3.5 times	4.9 times
Accounts Receivable	1.1 mo revenue	1.2 mo	1.4 mo	2.1 mo	2.4 mo

73. The strong liquidity position has been maintained throughout the last six years, but it has been strained in the current year by (i) the recent capital expenditure program and associated debt servicing costs, and (ii) a steady deterioration in collection performance. Capital expenditure in the past three years has doubled the value of TEPB's fixed assets, long-term debt

¹

Operating profit before interest and taxes as a percentage of average net assets at historical cost.

has increased fourfold, and accounts receivables have risen steadily from 1.1 months' average revenue at the end of FY1991 to stand at 2.4 months' at the end of FY1995 and are projected to rise to over 3 months' at the end of FY1996. TEPB is covenanted to maintain its debtors under 2 months' revenue. The debt-service cover has varied between 1.9 and 4.9 times during FY1991 to FY1995. It may decline to its minimum covenanted level of 1.3 in FY1996.

74. As of 30 April 1996, total electricity receivables were T\$2.99 million. Of this sum, over 25 percent was owed by Government departments and equaled about 8 months' billings. Up until July 1996, the largest delinquent was the Ministry of Finance for street lighting accounting for over 60 percent of the total Government debt to TEPB. Although the Government payments for street lighting were substantially settled in July 1996, TEPB, under its FY1996 - 97 budget, intends to enforce collection procedures more strictly with the objective to achieve a targeted level of 1.9 months by the end of the financial year.

75. The main actions needed by TEPB to meet the Bank covenants are (i) increased productivity — including an assessment of the need for the current staff levels — and reduction in the level of administration and overhead costs; (ii) improvement in the collection rate to levels achieved in the years prior to FY1994 to bring electricity accounts receivables down to under 2 months' average revenue (releasing some T\$1.8 million); and (iii) an adjustment in tariff rates and/or structure based on the findings of the advisory TA provided in conjunction with the Loan.

5. Projected Financial Performance

76. The projected financial statements of TEPB up to FY2005 are shown in Appendix 14 and summarized in Table 10.

Table 10: Summary of Projected Financial Performance
Year ending 30 June
(T\$'000)

Item	1996	1997	1998	1999	2000	2001
Sales (MWh)	27,619	28,983	30,417	31,904	33,328	34,737
Av. Revenue Yield (T\$/kWh)	0.3640	0.3822	0.3822	0.3822	0.4013	0.4013
Sales Revenue	10,053	11,077	11,626	12,194	13,373	13,940
Operating Profit	878	1,549	1,389	1,446	1,550	1,562
Net Profit	787	412	287	290	324	390
Fixed Assets	14,335	15,862	16,004	18,945	19,158	17,174
Total Capital Employed	17,694	17,892	20,892	22,036	22,523	22,246
Return on Average Net Fixed Assets	6.5%	10.9%	9.0%	8.3%	8.1%	8.6%
Debt -service Cover	9.3 times	2.6 times	2.5 times	1.8 times	2.0 times	2.1 times
Accounts Receivable	3.6 mo	2.3 mo	2.1 mo	1.9 mo	1.6 mo	1.6 mo.

77. The projections are based on the following: (i) energy sales and load forecasts made by the project preparatory TA consultants; (ii) the Project's capital expenditure projections and other budgeted capital expenditures; (iii) fuel cost estimates based on current prices and energy dispatch schedules reflecting expected plant efficiencies and availability; (iv) transmission and distribution losses being progressively reduced to an average of 8 percent by FY2005 — as projected by the project preparatory TA consultants — and maintained by system management and investment; (v) utilization of an average depreciation rate of 3.75 percent of historic cost, representing service lives of 25 years for the generating plant, 33 years for transmission and distribution equipment, and 5-10 years on other fixed assets; (vi) foreign cost inflation of 2.7 percent per year and local inflation of 4 percent; and (vii) progressive reduction of overdue receivables to covenanted levels. The Government has encouraged TEPB to recover the full costs of power production. There is therefore no external subsidization of energy consumers, however, in view of the flat rate tariff structure, some cross-subsidization exists. It is proposed that TEPB's overall tariff structure be reviewed in the associated advisory TA.

6. Compliance with Covenants

78. Details of compliance with loan covenants under the previous Bank-financed project (the Power Development Project) are provided in Appendix 15. TEPB satisfactorily complied with the majority of the covenants. In regard to financial performance covenants, a delay in the completion of a tariff study did not allow increasing the power charges until mid-1993. This prevented TEPB from achieving the covenanted 8 percent ROR until that year. The ROR exceeded the target in all subsequent years, but dropped from 21.6 percent in FY1994 to 8.8 percent in FY1995. A decline to below the covenanted level may eventuate in FY1996, influenced by increasing costs and inflation, and lack of a compensating tariff increase. The debt-service cover covenant has remained above the specified 1.3 times level; however, the less than 2 months' accounts receivables covenant was not complied with in FY1995, with 2.4 months' outstanding; and expected to exceed 3 months' in FY1996. TEPB has budgeted in FY1997 to reduce receivables to 1.9 months' by more strictly enforcing disconnection and other regulations.

79. Compliance with other covenants has generally been satisfactory, although production of quarterly project progress reports was irregular at times. Provision of funds by TEPB for operation and maintenance has been adequate. The BME system was partially implemented with the assistance of consultants under the advisory TA associated with the Loan. A modern, computerized MIS incorporating the primary system and financial performance indicators was installed. Full implementation of the BME system has been deferred to the proposed Project to permit staff to become familiar with the system, to allow enhancement of the computer software, and to provide training of staff in its use.

H. Environmental and Social Measures

1. Environment

80. An initial environmental examination (IEE) was undertaken for all components of the Project. The works to be provided under the Project essentially involve the rehabilitation and expansion of existing facilities. In Tongatapu, the power generation part of the Project covers the rehabilitation of the older section of the Popua Power Station. No additional plant or large-scale building works are to be installed or constructed. In Vava'u, a new power station was constructed under the previous project and provision was made for the later installation of additional generating sets. The two sets to be provided under the Project, and also those provided under

the previous project, are rated at about 300 kW (or about the size of large bulldozer engines), and the powerhouse and appurtenances require only small amounts of civil works and other minor structural additions, such as additional fuel tanks.

81. The usual major environmental impacts of such small diesel power stations are associated with the atmospheric pollution by diesel engine exhausts plus the effect of the generating plant noise on the local community. As regards possible exhaust pollution, all diesel generating units in TEPB's power stations utilize highly refined ADO, which has a low sulfur content. This ensures that sulfur dioxide and related gaseous emissions are reduced to a minimum. Noise at both the Tongatapu and Vava'u locations is not an issue as the power station sites are located in designated industrial areas remote from residential and commercial zones. The Project will have substantial environmental benefits for the Tongatapu part of the power generation project component in that new facilities are proposed to collect from the old section of the power station waste oil runoff currently discharged into the adjacent lagoon. The oil-laden water will be collected into collection sumps and disposed of by appropriate means. An additional environmental benefit of the Project will be the removal of an unsightly cooling water intake and screen structure from the lagoon shore. Cooling water for the rehabilitated generating units will be obtained from new bore holes to avail of fresh water from an underground lens.

2. Social Analysis

82. There are no social issues associated with the Project. Social acceptance for electric power supply is high, especially in outlying regions or islands where, traditionally, the supply is either nonexistent or of lower quality (varying voltage, frequent interruptions) than in the capital areas. The Project will benefit both the outer regions and islands by providing more reliable, efficient, and higher quality power supply by reducing voltage drops in lines (and the associated voltage fluctuations) and providing better controlled switching and more responsive action in the event of loss of supply or breakdown. Beneficiary participation has been sought by TEPB in the form of surveys of potential consumers in remote rural areas and outer islands presently without power. The demand for such service has been found to be very high and, in response, the Government's development policy supports electrification of outlying areas for both social and economic development reasons.¹

83. The beneficiaries of the Project are the TEPB electric power consumers of the four major islands of the Kingdom — Tongatapu, Vava'u, Ha'apai, and 'Eua — comprising residential consumers (79%), commercial/industrial (13%), and others (8%). Population distribution (1995 estimates) among the nation's four island groups is as follows: Tongatapu, 70,503; Vava'u, 15,315; Ha'apai, 7,504; 'Eua, 4,310; and Niua, 867. These comprise 99 percent of the total population of Tonga. Table 11 indicates the degree of electrification in each island supplied by TEPB. The electrification of the country is high, from 97 percent in Tongatapu to 46 percent in Ha'apai. Further electrification of Ha'apai is hindered by its atollic characteristic, with a series of smaller islands lying adjacent to, but at a considerable distance from, the main populated island. On Vava'u, the power distribution system is progressively being expanded, but is constrained by the mountainous terrain and the sparse settlement of the outlying areas. A TEPB-financed distribution expansion in the western part of the island, completed in November 1995, increased electrification from 77 to 85 percent. Progressive extensions to the Vava'u distribution system are planned under TEPB's capital expenditure budget in parallel with the Project.

¹ Electrification of remote islands such as the Niua and the outer islands of the Ha'apai group was studied under the Project's preparatory TA, and bilateral sources have expressed interest in funding the identified projects.

Table 11: Degree of Electrification

System	Number of Households	Number of Domestic Customers	Percent Connected
Tongatapu	11,917	9,414	97
Vava'u	2,547	2,164	85
Ha'apai	1,615	738	46
'Eua	790	737	93

84. The Project benefits thus will cover the major portion of the population. All consumers will benefit from the increased reliability (less load shedding) resulting from the rehabilitation and expansion of generating plant (in Tongatapu and Vava'u) and the rehabilitation of the four power distribution systems.

85. TEPB receives no subsidies from the Government for the operation of any of the four systems, although only Tongatapu and Vava'u are profitable. In view of the uniform tariff structure utilized for all systems, there is therefore cross-subsidization from the consumers of the two profitable systems to the consumers of the smaller Ha'apai and 'Eua systems.

I. Proposed Technical Assistance

86. It is proposed that advisory technical assistance in the amount of \$300,000 be provided for the institutional development of TEPB and rural electrification. The TA will comprise two components: (i) institutional development of TEPB, and (ii) assessment of the Government's rural/outer islands electrification program.

87. The first part of the TA will assist TEPB in furthering its corporatization process by strengthening its corporate planning, improving the efficiency of its operations (technical, managerial and commercial), updating an earlier tariff study, and providing enhancements to and associated staff training for its computerized accounting, budgeting, and MIS. Special attention will be given to staff training to build on the facilities provided under TA No. 1479-TON (see Appendix 16). In addition, issues relating to economy and efficiency of street lighting will be studied.

88. The second part of the TA will advise the Government on the financial implications of the existing and proposed diesel and PV rural electrification programs (proposed to be financed from bilateral sources), recommend a suitable entity to finance/operate/maintain the systems, advise on the level and source of subsidies, and advise on the charges and tariffs required for both the small diesel systems and the PV installations. The TA will also identify other islands where PV or other systems may be installed. (Presently, diesel-based systems are the responsibility of TEPB, whereas PV systems are under the aegis of the Energy Planning Unit of MLSNR.)

89. The TA will be implemented over a period of 12 months and is estimated to cost \$324,000 equivalent: \$300,000 to be financed by the Bank on a grant basis and \$24,000 equivalent to be financed by the Government and TEPB to cover office space, supplies and

equipment, and secretarial assistance. The Executing Agency will be the Ministry of Finance with implementation responsibility held by TEPB for the institutional strengthening part and by the Energy Planning Unit in the MLSNR for the rural electrification component. The required ten person-months of specialist input will be supplied by an international consulting firm with expertise in the areas of power utility institutional aspects, financial management, tariff and cost recovery aspects, PV and other energy generation/distribution systems engineering, and power systems economics. An international consulting firm will be selected and engaged in accordance with the Bank's *Guidelines on the Use of Consultants*. Terms of reference and cost estimates for the proposed advisory TA are attached as Appendix 17.

V. PROJECT JUSTIFICATION

A. Financial and Economic Analysis

1. Financial Evaluation

90. For TEPB, the Project will provide financial benefits derived from (i) incremental energy sales; (ii) lower energy generation and maintenance costs resulting from the rehabilitation and replacement of generating plant; (iii) substantially reduced distribution losses provided from the distribution refurbishment and losses reduction program, which will require a lower amount of generation for each unit sold; and (iv) increased system reliability due to generation plant and distribution system upgrading. Incremental energy sales are valued at projected real tariff levels. Generated power that displaces the output from existing inefficient units is valued in terms of fuel and operation/maintenance costs saved. The financial benefits of system losses reduction is analyzed by utilizing a corresponding lower level of generation for every unit of energy sold. The financial internal rate of return (FIRR) was calculated for the base case and then tested for adverse changes in key variables such as increases in capital costs and fuel costs, and decreases in energy output. The results are summarized in Table 12 for the three individual Project components.

Table 12: Financial Analysis

Variable	FIRR (%)		
	Tongatapu Generation	Vava'u Generation	Distribution Rehabilitation
Base Case	12.15	13.98	8.02
Capital Costs (+10%)	10.84	12.17	6.99
Fuel Costs (+20%)	10.15	11.67	-
Energy Output (-10%)	9.77	10.98	6.99

2. Economic Analysis

91. The least-cost generation solution for the Tongatapu system is the rehabilitation of the existing plant. This was shown with the use of an equalizing discount rate (EDR) analysis. Following this, the economic viability of each Project element was evaluated separately in terms of the economic net present value (ENPV) and economic internal rate of return (EIRR) as detailed in Appendix 18. The economic analysis is based on the comparison between the costs associated with the investment for the recommended project and the benefits derived from it. The benefits for

the whole Project are a consolidation of the individual analyses undertaken. Benefits are valued as incremental sales revenues with respect to a "without the Project" situation by considering the present tariff and a conservative consumer surplus as proxy for the users' willingness - to - pay.

92. The Project components are calculated to be economically viable with an EIRR of 14.4 percent and, assuming a 12 percent economic reference discount rate, an ENPV of T\$690,000. Table 13 shows the main economic indicators for the three project components.

Table 13: Economic Analysis

Component	ENPV (T\$'000)	EIRR (%)
Tongatapu Generation	465	14.5
Vava'u Generation	105	15.3
Distribution Rehabilitation	120	13.2

93. The investment appears robust at major variable modifications. Table 14 shows the EIRR at a 10 percent additional capital cost, 20 percent fuel cost increase, and a 10 percent output decrease for the three components and for the whole project.

Table 14: Sensitivity Analysis

Component	EIRR (%)		
	Capital Cost	Fuel Cost	Energy Output
	+10%	+20%	-10%
Tongatapu Generation	13.2	13.3	12.2
Vava'u Generation	13.4	13.6	12.3
Distribution Rehabilitation	11.9	11.1	12.2
Combined Project	12.8	12.6	12.2

3. Project Risks

94. The possible risks associated with the Project are (i) an increase in capital costs, (ii) delays in implementation, and (iii) lower than projected demand. Capital costs have been conservatively estimated and adequate provision made for physical contingencies and price escalation, thus substantially reducing this risk. Utilization of turnkey-type contracts for the major generation components, which incorporate design-supply-erect-commission provisions, will reduce the risk of construction delays. The provision of consultants to assist TEPB in design, specification, and procurement for the various contracts will also help reduce various risks. Demand projections (para. 21 and Appendix 3) have been conservatively estimated minimizing the risk of capacity underutilization.

95. Tonga is situated in a seismic zone with active volcanoes and has experienced earthquakes of reasonably high intensity. To avoid damage to the Project facilities, the structures and other project elements will be designed to internationally accepted seismically resistant standards. The Project area is also regularly affected by cyclones that destroy crops and damage

buildings and other infrastructure. The Project designs will also incorporate design standards to withstand such events.

96. The effect of the loan on the debt servicing of Tonga is relatively small. With this loan the total public debt will increase by 6 percent and the yearly debt service by 1.5 percent. The ratio of debt (disbursed and outstanding) to GDP is moderate at only 38 percent of GDP, over 90 percent of such debt being concessional. The DSR is one of the lowest in the Pacific region, increasing from 6.7 percent to 6.8 percent in recent years. Furthermore, the debt service due to this loan will produce its effect mainly in the next decade, after the 10-year grace period, when the country's total debt service is forecast to decrease.

97. This will be the second Bank-assisted power development project for TEPB. During implementation of the first power project, institutional weaknesses in TEPB were observed, particularly in the design and contract award stages. To reduce the likelihood of a recurrence of such delays, contract packaging has been simplified and the direct purchase of diesel units identical to those supplied under the original project has been authorized.

B. Project Benefits

98. Least-cost development plans for each of TEPB's systems have been investigated by the consultants. Generating plant installation programs have been recommended with a reserve capacity margin equal to the power output of the largest generating unit installed in the system. This provides the minimum acceptable reliability for the system: there will be no system load shedding during the peak demand periods when the largest generator may be out of service for maintenance or is forced out by a fault. The Project is thus designed to provide adequate generating capacity, with a reasonable reserve margin, to meet the increased load growth. The results of these analyses are shown in Appendix 19.

99. For the Tongatapu system, additional capacity is not required until 2003; however, this assumes the continued operation of all existing generating units in the Popua Power Station. Previous development plans had provided for the retirement of the four older units, given their age, and the likelihood of increasing costs of maintenance and possible scarcity of spare parts. The consultants and TEPB have established that the four diesel generators are of a particularly rugged design, that spare parts are plentiful (because of the large number of these types of sets sold), and that rehabilitation is the most economic solution. The rehabilitation of associate power station plant, auxiliaries, and structures will assure a continued further economic life of up to ten years.

100. For the Vava'u system, such options are not available for the existing sets in the Neiafu Power Station. The units are small, of relatively high speed, and in a powerhouse that is not economic or environmentally desirable to rehabilitate. New generating units are therefore needed to replace the old units, which will be scrapped. The new units will be of the same capacity and identical to the two units procured under the previous project, thus leading to further economies added to the higher efficiency gained from the new units.

101. The transmission and distribution components of the Project distribute power from the generating stations. Rehabilitation of these elements is required to reduce losses — especially in the outer island systems — and also to increase the security of supply and operational efficiency. A detailed justification for the various Project components is in Appendix 18.

VI. ASSURANCES

102. The Government and TEPB have given the following assurances, in addition to the standard assurances, which have been incorporated in the legal documents (the financial targets contained therein are identical to those incorporated in the Loan Agreement for the Power Development Project):

- (i) Rate of return. Except as otherwise agreed upon between the Government and the Bank, TEPB will take all necessary measures to ensure that the ratio of its net operating income to its average net fixed assets in operation is maintained at a minimum of 8 percent for each fiscal year.
- (ii) Debt service. Except as otherwise agreed upon between the Government and the Bank, TEPB will maintain its net revenues for each fiscal year at no less than 1.3 times the debt-service requirement for each fiscal year.
- (iii) Tariffs. Upon completion of the tariff review to be carried out under the proposed technical assistance, TEPB will, after consultation with the Government and the Bank, adopt such tariff level and structure as to ensure that TEPB satisfies its financial covenants.
- (iv) Accounts receivable.
 - (a) The Government and TEPB will, by no later than 30 June 1997, confirm to the Bank in writing that no amounts remain payable by TEPB to the Government, or by the Government to TEPB.
 - (b) TEPB will, by no later than 31 December 1997, reduce its accounts receivable to a level not exceeding two months' revenues and shall thereafter maintain said level.
 - (c) The Government will, after 30 June 1997, maintain all its accounts payable to TEPB accruing after that date to a level not exceeding two months' worth of purchases.
- (v) Amendment of the Tonga Electric Power Board Act. The Government and TEPB will communicate with the Bank on any impediments to the presentation of the proposed amendments to the TEPB Act (see paras. 58 to 61) and, after Bank review, seek its enactment as soon as reasonably possible thereafter in accordance with the Government's constitutional processes.
- (vi) System losses. TEPB will continue to implement a program to reduce its distribution energy losses in all its systems, with a view to reducing the aggregate losses to levels below 10 percent.
- (vii) Operation and maintenance. TEPB will be responsible for operation and maintenance of Project facilities, and the Government will ensure that sufficient funds and resources required for such operation and maintenance are provided on a timely basis.

VII. RECOMMENDATION

103. I am satisfied that the proposed loan would comply with the Articles of Agreement of the Bank and recommend that the Board approve the loan in various currencies equivalent to Special Drawing Rights 3,403,000 to the Kingdom of Tonga for the Second Power Development Project, with a service charge at the rate of 1 percent per annum and with an amortization period of 40 years, including a grace period of 10 years, and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan and Project Agreements presented to the Board.

7 November 1996

MITSUO SATO
President

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SUPPLEMENTARY APPENDIX
(available on request)

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TEPB INSTALLED DIESEL GENERATING PLANT

Unit No.	Manufacturer Engine/Generator	Engine Model	Year in Service	Capacity (kW)		Speed (rpm)	Proposed Retirement (year)
				Nominal	Available		
TONGATAPU							
Popua Power Station							
1.	Mirrlees Blackstone/Brush	KSS6	1972	1198	1018	428	2009
2.	Mirrlees Blackstone/Brush	KSS6	1972	1198	1018	428	2009
3.	Mirrlees Blackstone/Brush	KS Major	1979	1729	1470	500	2010
4.	Mirrlees Blackstone/Brush	KS Major	1981	1729	1470	500	2010
5.	Caterpillar	3512	late 1980s	945	803	1500	2000
6.	Mirrlees Blackstone/Brush	ESL16	1995	2136	1816	750	2015
7.	Mirrlees Blackstone/Brush	ESL16	1995	2136	1816	750	2015
Total Tongatapu Capacity				11071	9411		
VAVA'U							
Neiafu Power Station							
1.	Lister Blackstone/Harland & Wolff	EVS	pre 1960	150	128	600	1999
2.	Lister Blackstone/Harland & Wolff	EVS	pre 1960	150	128	600	1999
3.	Lister Blackstone/Harland & Wolff	EVS	pre 1960	150	128	600	1999
4.	Lister Blackstone/Harland & Wolff	EVS	pre 1960	150	128	600	1999
Taumu'aloto Power Station							
1.	Volvo/Newage	TWD1630G	1995	340	289	1500	2010
2.	Volvo/Newage	TWD1630G	1995	340	289	1500	2010
Total Vava'u Capacity				1280	1090		
HA'APAI							
Pangai Power Station							
1.	Dorman/Kato	20893	1982	56	48	1000	2000
2.	Dorman/Kato	20893	1982	56	48	1000	2000
3.	Cummins/Newage	220DFBE	1994	200	170	1500	2009
4.	Cummins/Newage	220DFBE	1994	200	170	1500	2009
Total Ha'apai Capacity				512	436		
'EUA							
Ohonua Power Station							
1.	Dorman/Kato	20893	1983	56	48	1000	2005
2.	Dorman/Kato	20893	1983	56	48	1000	2005
3.	Gardner/Newage	n.a.	n.a.	80	68	1500	2005
4.	Volvo/Newage	TAD730G	1995	150	128	1500	2010
5.	Volvo/Newage	TAD730G	1995	150	128	1500	2010
Total 'Eua Capacity				492	420		

Notes:

1. Available capacity of a generating unit is defined as 85% of nominal capacity.
2. All units have a power factor of 0.8 and generate at 50Hz.
3. Caterpillar unit was obtained in used condition in 1993.
4. "n.a." indicates information is not available.

Year	Gross Generation (GWh)	Own Use (GWh)	Net Generation (GWh)	Peak Demand (MW)	Load Factor (%)	Annual Increase (%)	
						Net Generation	Peak Demand
Tongatapu System							
1985	13.004	0.508	12.496	2.410	61.6		
1986	13.835	0.545	13.290	2.650	59.6	6.4	10.0
1987	15.613	0.715	14.898	3.210	55.5	12.1	21.1
1988	17.316	0.713	16.603	3.230	61.2	11.4	0.6
1989	18.940	0.787	18.153	3.520	61.4	9.3	9.0
1990	20.978	0.851	20.127	3.850	62.2	10.9	9.4
1991	21.554	0.928	20.626	3.990	61.7	2.5	3.6
1992	23.231	1.012	22.219	4.475	59.3	7.7	12.2
1993	23.718	0.854	22.864	4.470	60.6	2.9	-0.1
1994	25.013	0.950	24.063	4.888	58.4	5.2	9.4
1995	27.002	0.942	26.060	5.000	61.6	8.3	2.3
Average growth rates 1990-1995 (%)						5.3	5.4
Vava'u System							
1985	1.211	0.036	1.175	0.300	46.1		
1986	1.316	0.042	1.274	0.330	45.5	8.4	10.0
1987	1.477	0.039	1.438	0.375	45.0	12.9	13.6
1988	1.924	0.048	1.876	0.460	47.7	30.5	22.7
1989	2.122	0.056	2.066	0.550	44.0	10.1	19.6
1990	2.383	0.061	2.322	0.520	52.3	12.4	-5.5
1991	2.474	0.067	2.407	0.540	52.3	3.7	3.8
1992	2.452	0.073	2.379	0.530	52.8	-1.2	-1.9
1993	2.565	0.068	2.497	0.585	50.1	5.0	10.4
1994	2.805	0.069	2.736	0.600	53.4	9.6	2.6
1995	2.885	0.085	2.800	0.625	52.7	2.3	4.2
Average growth rates 1990-1995 (%)						3.8	3.8
Ha'apai system							
1985	0.149	0.004	0.145	na			
1986	0.161	0.005	0.156	na		7.6	
1987	0.219	0.009	0.210	na		34.6	
1988	0.301	0.010	0.291	na		38.6	
1989	0.425	0.009	0.416	na		43.0	
1990	0.525	0.010	0.515	na		23.8	
1991	0.617	0.010	0.607	0.170	41.4	17.9	
1992	0.570	0.007	0.563	0.170	38.3	-7.2	0.0
1993	0.631	0.012	0.619	0.163	44.2	9.9	-4.1
1994	0.655	0.010	0.645	0.170	44.0	4.2	4.3
1995	0.796	0.009	0.787	0.197	46.1	22.0	15.9
Average growth rates 1992-1995 (%)						6.7	3.8

Year	Gross Generation (GWh)	Own Use (GWh)	Net Generation (GWh)	Peak Demand (MW)	Load Factor (%)	Annual Increase (%)	
						Net Generation	Peak Demand
'Eua System							
1985	0.042	0.005	0.037	na			
1986	0.050	0.005	0.045	na		21.6	
1987	0.116	0.009	0.107	na		137.8	
1988	0.174	0.008	0.166	na		55.1	
1989	0.281	0.008	0.273	na		64.5	
1990	0.323	0.009	0.314	na		15.0	
1991	0.365	0.009	0.356	0.165	25.3	13.4	
1992	0.389	0.009	0.380	0.165	26.9	6.7	0.0
1993	0.428	0.009	0.419	0.140	34.9	10.3	-15.2
1994	0.492	0.008	0.484	0.166	33.8	15.5	18.6
1995	0.499	0.011	0.488	0.165	34.5	0.8	-0.6
Average growth rates 1992-1995 (%)						8.2	0
TEPB Systems Total							
1985	14.406	0.553	13.853	2.710			
1986	15.362	0.597	14.765	2.980		6.6	
1987	17.425	0.772	16.653	3.585		12.8	
1988	19.715	0.779	18.936	3.690		13.7	
1989	21.768	0.860	20.908	4.070		10.4	
1990	24.209	0.931	23.278	4.370		11.3	
1991	25.010	1.014	23.996	4.865	58.7	3.1	
1992	26.642	1.101	25.541	5.340	57.0	6.4	9.8
1993	27.342	0.943	26.399	5.358	58.3	3.4	0.3
1994	28.965	1.037	27.928	5.824	56.8	5.8	8.7
1995	31.182	1.047	30.135	5.987	59.5	7.9	2.8
Average growth rates 1992-1995 (%)						5.9	5.7

- Notes:
1. Data are for fiscal years ending on 30 June of year indicated.
 2. Load factor is computed using peak demand, gross generation, and hours in a year.
 3. TEPB total peak demand is noncoincidental. It is the sum of Tongatapu and Vava'u system peak demands to 1990 and the sum of all four systems thereafter.
 4. "na" indicates that information is not available.

TEPB SYSTEMS ENERGY GENERATION AND PEAK DEMAND FORECASTS
Individual Systems and Consolidated

Item	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TONGATAPU											
Net Generation (MWh)	26,060	26,673	28,017	29,459	30,678	31,724	33,082	34,501	35,983	37,532	38,724
Distribution Losses											
Amount (MWh)	3,755	2,881	3,026	3,181	3,068	2,855	2,978	3,105	3,238	3,377	3,098
Percent	14.41	10.80	10.80	10.80	10.00	9.00	9.00	9.00	9.00	9.00	8.00
Sales (MWh)	22,305	23,792	24,991	26,278	27,610	28,869	30,104	31,396	32,745	34,155	35,626
Load Factor (%)	61.6	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Peak Demand (kW)	5,012	5,283	5,547	5,832	6,074	6,281	6,549	6,830	7,124	7,431	7,667
Growth Rate (% p.a.)		5.4	5.0	5.1	4.1	3.4	4.3	4.3	4.3	4.3	3.2
VAVA'U											
Net Generation (MWh)	2,799	3,365	3,509	3,478	3,475	3,486	3,541	3,677	3,819	3,970	4,128
Distribution Losses											
Amount (MWh)	546	656	684	556	452	349	283	294	305	318	330
Percent	19.5	19.5	19.5	16.0	13.0	10.0	8.0	8.0	8.0	8.0	8.0
Sales (MWh)	2,253	2,709	2,825	2,922	3,023	3,137	3,258	3,383	3,514	3,652	3,798
Load Factor (%)	52.7	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0	53.0
Peak Demand (kW)	625	747	779	772	772	774	786	816	848	881	917
Growth Rate (% p.a.)		19.5	4.3	-0.9	0.0	0.3	1.6	3.8	3.9	3.9	4.1
HA'APAI											
Net Generation (MWh)	789	832	866	872	875	889	915	945	981	1017	1056
Distribution Losses											
Amount (MWh)	138	145	150	125	97	80	73	75	79	81	84
Percent	17.5	17.4	17.3	14.3	11.1	9.0	8.0	7.9	8.1	8.0	8.0
Sales (MWh)	651	687	716	747	778	809	842	870	902	936	972
Load Factor (%)	46.3	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
Peak Demand (kW)	197	213	222	224	224	228	235	242	252	261	271
Growth Rate (% p.a.)		8.1	4.2	0.9	0.0	1.8	3.1	3.0	4.1	3.6	3.8
'EUA											
Net Generation (MWh)	510	523	547	548	541	557	580	603	627	652	678
Distribution Losses											
Amount (MWh)	108	92	96	77	48	45	47	48	51	52	54
Percent	21.2	17.6	17.6	14.1	8.9	8.1	8.1	8.0	8.1	8.0	8.0
Sales (MWh)	402	431	451	471	493	512	533	555	576	600	624
Load Factor (%)	34.6	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Peak Demand (kW)	172	180	188	188	186	191	199	207	215	224	233
Growth Rate (% p.a.)		4.7	4.4	0.0	-1.1	2.7	4.2	4.0	3.9	4.2	4.0
TEPB TOTAL											
Net Generation (MWh)	30,137	32,450	33,451	34,572	35,752	36,825	37,937	39,559	41,254	43,027	44,880
Distribution Losses											
Amount (MWh)	4,526	4,805	4,364	4,031	3,703	3,351	3,035	3,165	3,300	3,442	3,590
Percent	15.02	14.81	13.05	11.66	10.36	9.10	8.00	8.00	8.00	8.00	8.00
Sales (MWh)	25,611	27,619	28,983	30,418	31,904	33,327	34,737	36,204	37,737	39,343	41,020
Noncoincident Peak Demand (kW)	6,006	6,423	6,736	7,016	7,256	7,474	7,769	8,095	8,439	8,797	9,088
Growth Rate (% p.a.)		6.9	4.9	4.2	3.4	3.0	3.9	4.2	4.2	4.2	3.3

Notes: 1. Peak demand values do not include station auxiliary use.
2. Individual system peak demands not coincidental.

HISTORY OF TEPB ELECTRICITY TARIFFS

Table 1: TEPB Published Power Tariffs
(T\$)

Effective Date	Tongatapu			Other Branches		
	Minimum Charge	Base Rate	Surcharge	Minimum Charge	Base Rate	Surcharge
			Total Charge			Total Charge
Sep 1985	2.60	0.2290	0.0000	2.65	0.2343	0.0000
Jul 1986	2.84	0.2385	0.0000	2.89	0.2440	0.0000
May 1990	3.01	0.2385	0.0147	3.03	0.2440	0.0147
Oct 1990	3.14	0.2385	0.0252	3.14	0.2440	0.0252
Jan 1991	4.33	0.2385	0.1252	4.38	0.2440	0.1252
Feb 1991	4.01	0.2385	0.0982	4.06	0.2440	0.0982
May 1991	3.65	0.2385	0.0708	3.70	0.2440	0.0708
Oct 1991	3.71	0.2385	0.0708	3.70	0.2440	0.0708
Dec 1991	3.85	0.2385	0.0828	3.91	0.2440	0.0828
Jan 1992	3.85	0.2385	0.0920	3.91	0.2440	0.0920
Feb 1992	3.90	0.2385	0.0866	3.96	0.2440	0.8660
Mar 1992	3.83	0.2385	0.0811	3.89	0.2440	0.0811
Apr 1992	3.72	0.2385	0.0724	3.78	0.2440	0.0724
Jun 1992	3.84	0.2385	0.0824	3.90	0.2440	0.0824
Aug 1992	4.08	0.2385	0.1025	4.14	0.2440	0.1025
Sep 1992	4.06	0.2385	0.1007	4.12	0.2440	0.1007
Oct 1992	3.98	0.2385	0.0935	4.04	0.2440	0.0935
Nov 1992	4.02	0.2385	0.9680	4.08	0.2440	0.0968
Dec 1992	4.11	0.2385	0.1042	4.17	0.2440	0.1042
Jul 1993	4.11	0.2558	0.1042	4.17	0.2613	0.1042
Mar 1994	4.32	0.3600	0.0000	4.39	0.3655	0.0000

Note: Figures for Minimum Charge are in T\$, all others are in T\$/kWh.

Table 2: TEPB Average Power Tariffs

Fiscal Year	Annual Sales (MWh)				Electricity Sales Revenues (T\$ million)				GDP Deflator 1994-95 = 100	Average Tariff (T\$/kWh)		
	Tongatapu	Vava'u	Ha'apai	Eua	Total	Tongatapu	Vava'u	Ha'apai		Eua	Total	Current Prices
1985	10,606.3	988.2	123.5	32.4	11,750.4	2,283.5	218.5	28.2	8.4	2,538.6	0.216	0.445
1986	11,333.8	1,069.90	128.6	41.9	12,574.2	3,009.0	288.9	35.9	12.6	3,346.4	0.266	0.472
1987	12,573.1	1,150.60	196.8	98.3	14,018.8	3,181.3	304.2	51.1	28.3	3,564.9	0.254	0.406
1988	14,022.7	1,467.00	288.4	163.3	15,941.4	3,584.0	387.0	74.9	43.1	4,069.0	0.255	0.374
1989	15,530.8	1,654.70	364.6	241.7	17,791.8	3,928.0	428.1	94.2	63.3	4,513.6	0.254	0.345
1990	17,360.6	1,909.40	451.4	290.1	20,011.5	4,397.1	489.0	116.9	76.2	5,079.2	0.254	0.311
1991	17,485.5	1,986.60	496.0	317.0	20,285.1	5,640.8	629.8	154.3	102.1	6,527.0	0.322	0.358
1992	18,563.6	1,971.40	502.0	330.0	21,367.0	6,201.6	663.8	167.7	113.4	7,146.5	0.334	0.347
1993	19,283.0	2,131.10	534.0	360.0	22,308.1	6,971.9	811.6	192.4	133.0	8,108.9	0.363	0.364
1994	20,231.0	2,195.90	543.0	374.0	23,343.9	7,757.6	831.4	209.8	153.5	8,952.3	0.383	0.384
1995	22,304.7	2,253.20	651.5	402.0	25,611.4	8,438.8	864.5	248.5	155.8	9,707.6	0.379	0.379

	1991/92	1992/93	1993/94	Past 3 Years Annual Average	1994/95 Program
A. By Major Source (\$ million)					
Multilateral Assistance (ODA NET)					
Asian Development Bank	2.2	1.6	2.8	2.2	1.2
European Union a	-0.1	1.1	2.6	1.2	-
International Development Association	1.0	0.1	0.2	0.4	0.6
International Fund for Agricultural Development	0.6	0.2	0.5	0.4	0.7
United Nations Development Programme	0.5	0.3	0.5	0.4	0.4
United Nations Technical Assistance a	0.6	0.5	0.8	0.6	-
Others b	0.1	0.2	0.3	0.2	-
Subtotal	4.9	4.0	7.7	5.5	2.9
Bilateral Assistance					
Australia	7.6	8.7	7.1	7.8	8.6
France	0.2	0.2	0.2	0.2	0.3
Germany	0.3	1.4	0.2	0.6	0.6
Japan	3.4	5.3	12.0	6.9	7.8
New Zealand	2.8	3.4	4.6	3.6	5.6
United Kingdom	0.1	0.1	0.1	0.1	0.2
Subtotal	14.4	19.1	24.2	19.2	23.1
Total	19.3	23.1	31.9	24.8	26.0
B. By Sector Development Commitments (%)					
Natural Resources/Agriculture				7.3	8.2
Energy				19.7	10.3
Industry/Minerals				0.0	0.3
Finance				1.7	2.0
Transport and Communications				14.7	21.0
Social Infrastructure				48.0	49.0
Multisector/Others				8.3	9.2
Total				100.0	100.0

b Others (multilateral) not specified.

Source: Central Planning Department (Tonga), ADB.

DETAILED DESCRIPTION OF THE PROJECT

1. The Project will provide facilities for the Tonga Electric Power Board (TEPB), including new electric power generation plant in an existing system and the rehabilitation of old generating plant. The existing power distribution facilities in TEPB's four island systems will be rehabilitated and reconfigured to reduce losses, and augmented to increase their reliability and ease of control. Consulting services will be provided to assist TEPB in the design, procurement, and installation of the Project's plant and facilities and conduct additional studies, where necessary. Details of these facilities are described below:

1. Power Generation Rehabilitation in Tongatapu

2. The four older diesel generating units (Units 1 to 4 comprising two generators of 1198 kW, and two of 1729 kW) and associated systems and appurtenances in Popua Power Station will be rehabilitated:

- (i) Engine refurbishment/overhauls. All engine running parts for three of the four units which require major overhaul, including new cylinder liners, new cylinders, piston rings; big and small end bearings; crankshaft bearings; filters, gaskets, seals, and other replacement parts.
- (ii) Engine on-board auxiliaries. The supply and installation of all on-board engine indication and control (I&C) systems and devices, local control panels, start and automatic runup control systems, start air system, fuel system (including pumps, piping, supports, rack mechanisms etc.), lube oil equipment, engine cooling systems (including provision of a chemical treatment facility), excitation and automatic voltage regulating systems;
- (iii) Power station facilities.
 - (a) station mechanical systems and auxiliary equipment comprising raw cooling water systems, fuel oil systems, lube oil systems, compressed air systems, air intake systems, exhaust systems, waste oil and sludge disposal systems, and spare parts for them;
 - (b) station electrical and I&C systems and equipment comprising high-voltage switchgear, protective relaying and metering, station and unit power service system and motor control centers, units and auxiliary systems I&C; and
 - (c) power house structural/civil works comprising external wall recladding, rebuild/resurface stub walls, restore doors, windows, fixtures; demolish, as necessary, internal walls, structures, stairwells etc.; rebuild/rework internal walls, stairs, etc.; clean/repaint all steelworks; restore/repaint all floors, trenches, pits, trench metal covers; design/install new engine hall ventilation system, air-condition control room, etc.; refurbish all building services, plumbing, lighting, and engine hall overhead crane and structure; extension and establishment of operating/maintenance staff facilities.

2. Power Generation Expansion in Vava'u

3. Additional diesel generators and associated equipment and facilities at the existing new Taumu'aloto Power Station in Vava'u will be provided including

- (i) two new 300-kW, 1,500 rpm, radiator-cooled diesel generating units with all necessary auxiliary systems and services equipment;
- (ii) new foundations; second 54,000-liter bulk fuel oil storage tank, fuel delivery system;
- (iii) extension of existing main control desk; extension of main 415-V switchgear; and
- (iv) extension of the 415/240-V station service system, additional powerhouse ventilation fans.

3. Power Distribution Systems Upgrading

4. The power distribution systems of Tongatapu, Vava'u, Ha'apai, and 'Eua will be augmented and rehabilitated and facilities will be installed to improve the performance and to reduce energy losses in the systems to acceptable levels:

- (i) Completion of Phase I system losses reduction with:
 - (a) installation of 1200 kVARs of capacitors on Tongatapu high voltage lines, and installation of 200 kVARs of capacitors on Vava'u high voltage lines;
 - (b) installation of equipment and materials for reconfiguration of part of residential and commercial LV networks on all TEPB systems; install additional HV line extensions;
 - (c) supply and installation of additional distribution transformers on all systems.
- (ii) Phase II system losses reduction by
 - (a) upgrading the remaining 6.6-kV feeders on Tongatapu to 11 kV;
 - (b) instituting a program for field and laboratory testing of consumer meters;
 - (c) continuing the program of resealing in-service meters; and
 - (d) establishing a program for continuous updating and review of monthly billing records.
- (iii) System security improvements through
 - (a) establishing a load dispatch center with load shedding facility;

(b) replacing the Vaini feeder termination structure at Popua Power Station;
and

(c) instituting a low voltage pole replacement program.

4. Distribution Infrastructure Improvements

- (i) distribution center refurbishment/upgrade,
- (ii) high-voltage switchgear replacement, and
- (iii) new distribution facilities for Popua Power Station .

5. Miscellaneous

- (i) computer hardware/software for distribution systems analysis,
- (ii) distribution system tools and equipment, and
- (iii) training (generation, I&C).

6. Consulting Services

- (i) generation systems,
- (ii) distribution systems,
- (iii) system studies, and
- (iv) domestic consultants.

DETAILED PROJECT COST ESTIMATES

Item	Estimated Costs (\$'000)			Duty Rate (%)
	Foreign	Local	Total	
A. Base Cost				
1. Generation Plant Rehabilitation Popua Power Station, Tongatapu - Units 1 to 4	1,510	725	2,235	
2. Generation Plant Expansion Vava'u 2 x 300-kW Generators	445	180	625	25
3. Distribution Systems Upgrading Completion of 1993 Defined Loss Reduction Measures (Phases I & II) Improvements to System Security	410 460	275 195	685 655	35 20
4. Distribution Infrastructure Improvement Distribution Center Switchgear Upgrade Distribution Department Facilities	100 20	100 25	200 45	20 20
5. Equipment & Materials Computer Hardware/Software Distribution Appliances/Tools Training Waste Oil Incinerator (Optional)	120 180 50 120	— — — —	120 180 50 120	
6. Consulting Services Generation (12 person-months) Distribution (4 person-months) System Studies (2 person-months) Domestic Consultant (6 person-months)	275 90 50 —	50 15 — 120	325 105 50 120	
Subtotal (A)	3,830	1,685	5,515	
B. Contingencies				
1. Physical ^a	380	170	550	
2. Price ^b	540	345	885	
Subtotal (B)	920	515	1,435	
C. Loan Service Charges				
	150	—	150	
TOTAL (A+B+C)	4,900	2,200	7,100	
Percent	70	30	100	

— = magnitude zero.

a Calculated at 10 percent of base costs.

b Escalation rates utilized: Foreign exchange, 2.7% pa; Local currency, 4.0% pa.

Source: Staff estimates.

	1996	1997	1998	1999	2000	2001																														
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Project Component																																				
Consultants Selection	<div>- Loan Approval</div>																																			
Shortlisting/Proposals/Evaluation	<div>- Consultants Appointed</div>																																			
Popus Power Station Rehabilitation																																				
Design/Specify																																				
Tender/Contract Award																																				
Manufacture/Delivery																																				
Generators and Auxiliaries Rehabilitation																																				
Staff Training																																				
Power House Refurbishment																																				
Vava'u Generation Additions																																				
Design/Specify																																				
Tender/Contract Award																																				
Manufacture/Delivery																																				
Installation/Commissioning																																				
Distribution Losses Reduction																																				
Losses Review Study																																				
Design/Specify																																				
Materials Procurement/Manufacture																																				
Materials Delivery																																				
Complete Loss Reduction Program																																				
Distribution Systems Upgrading																																				
System Security Study																																				
Design/Specify																																				
Materials Procurement/Delivery																																				
Contracting for Local Minor Works																																				
Establish Load Despatch																																				
LV Pole Replacement																																				
Old Distribution Center Rehabilitation																																				
Design/Specify																																				
Tender/Contracting																																				
HV Switchgear Replacement																																				
Maintenance Vehicle Facilities																																				
Staff Training																																				

BANK-FINANCED PROJECT CONTRACT PACKAGES

Project Part	Package Number	Description	Procurement Mode ^a
A		Project Part A - Generation Plant Rehabilitation	
	1	Popua Power Station, Tongatapu, Rehabilitation - A turnkey contract for the detailed design, supply, delivery, installation/rehabilitation, testing, and commissioning of the equipment, plant, and civil/structural works required for the rehabilitation of the original part of the Popua Power Station containing diesel generating Units No. 1,2,3, and 4.	ICB
B		Project Part B - Generation Plant Expansion	
	2	Taumu'aloto Power Station, Vava'u, Generation Expansion - A turnkey contract for the supply, delivery, installation, testing and commissioning of two 300-kW (nominal) diesel generators identical to the two 340-kW generating units, auxiliary systems, switchgear, and associated systems supplied under the Bank-assisted Power Development Project (Loan No.1079-TON[SF]).	DP
C		Project Part C - Distribution Systems Upgrading	
	3	Various contracts/purchase orders for the supply and delivery of rehabilitation/losses reduction distribution materials and equipment for the 415/240 V LV networks on Tongatapu, Vava'u, Ha'apai and 'Eua.	IS and DP
	4	Various contracts/purchase orders for the supply of 11 kV transmission line materials and equipment to convert 53 km of 6.6 kV lines to 11 kV.	IS and DP
D		Project Part D - Distribution Infrastructure Improvements	
	5	Various contracts/purchase orders for upgrading the security of the power distribution systems including a load shedding facility, wood pole replacements, new underwater cable terminations, high-voltage switchgear replacements, vehicle maintenance facilities, and control center refurbishments.	IS and DP
E		Project Part E - Equipment and Materials	
	6	Equipment, tools, and materials for maintenance and testing of the distribution systems; Computer equipment and software for a distribution system geographical and data base asset information system.	IS and DP
F		Project Part F - Consulting Services	
	7	Consulting engineering services for the design, specification, contracting, and construction supervision of the Project.	ICB

^a ICB = international competitive bidding, DP = direct purchase, IS = International shopping.

TERMS OF REFERENCE FOR CONSULTING SERVICES

A. Introduction

1. The Second Power Development Project in the Kingdom of Tonga is being partly financed by a Bank loan for which engineering consulting services are required to assist the Executing Agency, Tonga Electric Power Board (TEPB), in implementation. The Project covers installations on the four major islands of Tongatapu, Vava'u, Ha'apai, and 'Eua. It comprises the provision of power generation rehabilitation on Tongatapu, power generation expansion on Vava'u, and the rehabilitation, reliability enhancement, and reduction of losses in the power distribution systems on all four islands. Rehabilitation of the power station facilities in the Popua powerhouse in Tongatapu will provide for refurbishment of diesel generator auxiliaries, controls, and services equipment associated with the four older generating units (unit nos. 1 to 4). The overhaul of engine no.1 will not be provided under the Project as a major overhaul of this machine is being undertaken in 1996 under TEPB financing. This work was well overdue at the time of appraisal.

2. The Project is divided into two parts (Part A and Part B). Part A is defined by the power generation components corresponding to the Tongatapu generation plant rehabilitations and the Vava'u generation plant expansion. Part B comprises the distribution systems works, including the reliability improvement and losses reduction facilities for the Tongatapu, Vava'u, Ha'apai, and 'Eua systems.

B. Scope of Work/Terms of Reference

3. The consultant will perform the following tasks:

1. Project Part A - Power Generation

- (i) Review all relevant reports, data, and information available from previous studies and investigations, and obtain further information, as may be available, from TEPB, the Government, and other organizations; and take cognizance of any changes in project scope or design, which have been incorporated in the Loan documents
- (ii) Briefly review the systems' load projections, recently developed under the Feasibility Study, and modify them to take into account newly announced load additions and use these as a basis for the needed revision of the generation development program
- (iii) Carry out the necessary site investigations and assessments at each power station site; and prepare detailed lists of plant, equipment, materials, and works required for the Project
- (iv) Utilizing the proposed procurement modes outlined in the Loan documents, determine the optimum bid packages, taking into account the requirements of the Bank's *Guidelines for Procurement*

- (v) Undertake the required detailed engineering designs of the subprojects including plant specifications, bills of quantities, civil/structural designs, and refurbishments, and design drawings
- (vi) Prepare draft bidding documents including invitations to bid, instructions to bidders, forms of tender, general conditions, schedule of prices, conditions of contract, etc., in accordance with TEPB's general practices and the Bank's procurement requirements
- (vii) Revise Project cost estimates based on the tender designs broken down into the various components identified in the Feasibility Report and the Loan documents
- (viii) Submit the draft bidding documents and revised Project cost estimates to TEPB and the Bank for review and approval
- (ix) Revise the draft bidding documents in accordance with comments received
- (x) Issue invitations to bid or undertake procurement in accordance with the Bank's *Guidelines for Procurement* for international competitive bidding, international shopping, local competitive bidding or direct procurement, as appropriate
- (xi) Evaluate bids received to obtain the lowest commercially and technically acceptable, conforming bid price; utilize tendered performance specifications to obtain least-cost evaluated prices for all plant and machinery, as appropriate
- (xii) Prepare bid evaluation reports to incorporate all evaluation procedures utilized, clarification correspondence undertaken with the various bidders, and calculation of evaluated prices; and submit copies of such reports to TEPB and the Bank for review and approval
- (xiii) Assist TEPB with contract negotiations with the approved preferred lowest priced bidders
- (xiv) Provide assistance to TEPB in the coordination and supervision of contracts
- (xv) Prepare a critical path program for contract award and administration, and installation/construction supervision
- (xvi) Assist TEPB in site supervision and construction supervision
- (xvii) Assist TEPB in the preparation of a comprehensive Project completion report covering all major aspects of the subproject.

2. Project Part B - Distribution Systems

- (i) Assist TEPB with the identification of materials and equipment quantities to complete the distribution losses reduction program
- (ii) Carry out a review of TEPB's specifications utilized for the procurement of distribution equipment and materials, determine their compliance with international/national standards, and confirm that transformer losses are being evaluated in compliance with previously developed evaluation criteria
- (iii) Provide assistance to TEPB in identifying prioritized distribution system reconfiguration and reinforcement programs, which will provide maximum reduction in losses
- (iv) Review the existing primary 6.6-kV and 11-kV distribution system layout in Tongatapu and recommend an optimized rearrangement to provide for the upgrading or replacement of the 6.6-kV lines
- (v) Review the configuration and controls of the existing street lighting systems; recommend means by which, preferably by remote control, the extent and/or the duration of the street lighting may be controlled to reduce energy consumption; review wattage and efficiency of existing street lamps and recommend any possible measures to increase their efficiency
- (vi) Prepare a critical path program for the works and revise cost estimates in accordance with the agreed upon, revised program
- (vii) On an as-needed basis and, at the request of TEPB,
 - (a) provide assistance to TEPB as may be required for the satisfactory completion of the works;
 - (b) provide on-the-job training of TEPB staff to develop their capability in various aspects of the works; and
 - (c) provide coordination and supervision of contractors, as required, for aspects of the subproject.

3. General

- (i) Assist TEPB in the design and implementation of a Project benefit and monitoring system covering salient measures and indices of the power systems' performance and benefits derived by consumers
- (ii) Assist TEPB in the preparation of quarterly progress reports on the tasks covered by these terms of reference
- (iii) Assist TEPB in the production of a Project completion report covering major tasks included in the consultants' terms of reference.

PROJECT BENEFIT MONITORING AND EVALUATION

Typical Benefit Monitoring Indicators and Performance Measures Applicable to Tonga Electric Power Board

A. Indicators

1. The indicators for a management information system (MIS) shown below are suitable for a small power utility such as TEPB. There are three categories of indicators which cover major aspects of the operation of the utility: (i) production, (ii) service and consumption, and (iii) financial. Typical indicators would comprise the following:

1. Power Production

- System Peak Demand (kW)
- Total Energy, Sent Out (GWh)
- Energy Output (Gross and Net) of Each Generating Unit (GWh)
- Total Generation Energy Losses (GWh)
- Energy Losses of Each Generating Unit (GWh)
- Power Station Aggregate Fuel Efficiency (l/KWh)
- Generating Unit Fuel Efficiency (l/KWh)
- Total Fuel Consumption (kl)
- Generating Unit Forced Outage Time (h)

2. Service and Consumption

- Total System Energy Losses (GWh)
- System Technical Losses (GWh)
- System Nontechnical Losses (GWh)
- High-Voltage Line Losses (GWh)

- Load Shedding Outage Time (h)
- Load Shedding Sales Losses (GWh)

- Total Service Connections (no.)
- Domestic Connections (no.)
- Commercial/Industrial Connections (no.)
- Street Lighting Luminaries (no.)

- Total Energy Sales (GWh)
- Domestic Energy Sales (GWh)
- Commercial/Industrial Energy Sales (GWh)
- Street Lighting Energy Sales (GWh)

3. Financial

Total Energy Sales Billings (T\$)
 Domestic Energy Sales Billings (T\$)
 Commercial/Industrial Energy Sales Billings (T\$)
 Street Lighting Energy Sales Billings (T\$)
 Total Collections (T\$)
 Domestic Collections (T\$)
 Commercial/Industrial Collections (T\$)
 Street Lighting Collections (T\$)

B. Performance Measures

2. The following performance measures may be computed from the indicators described above. They may be used to compare performance over time (from one month to the next or from one year to the next).

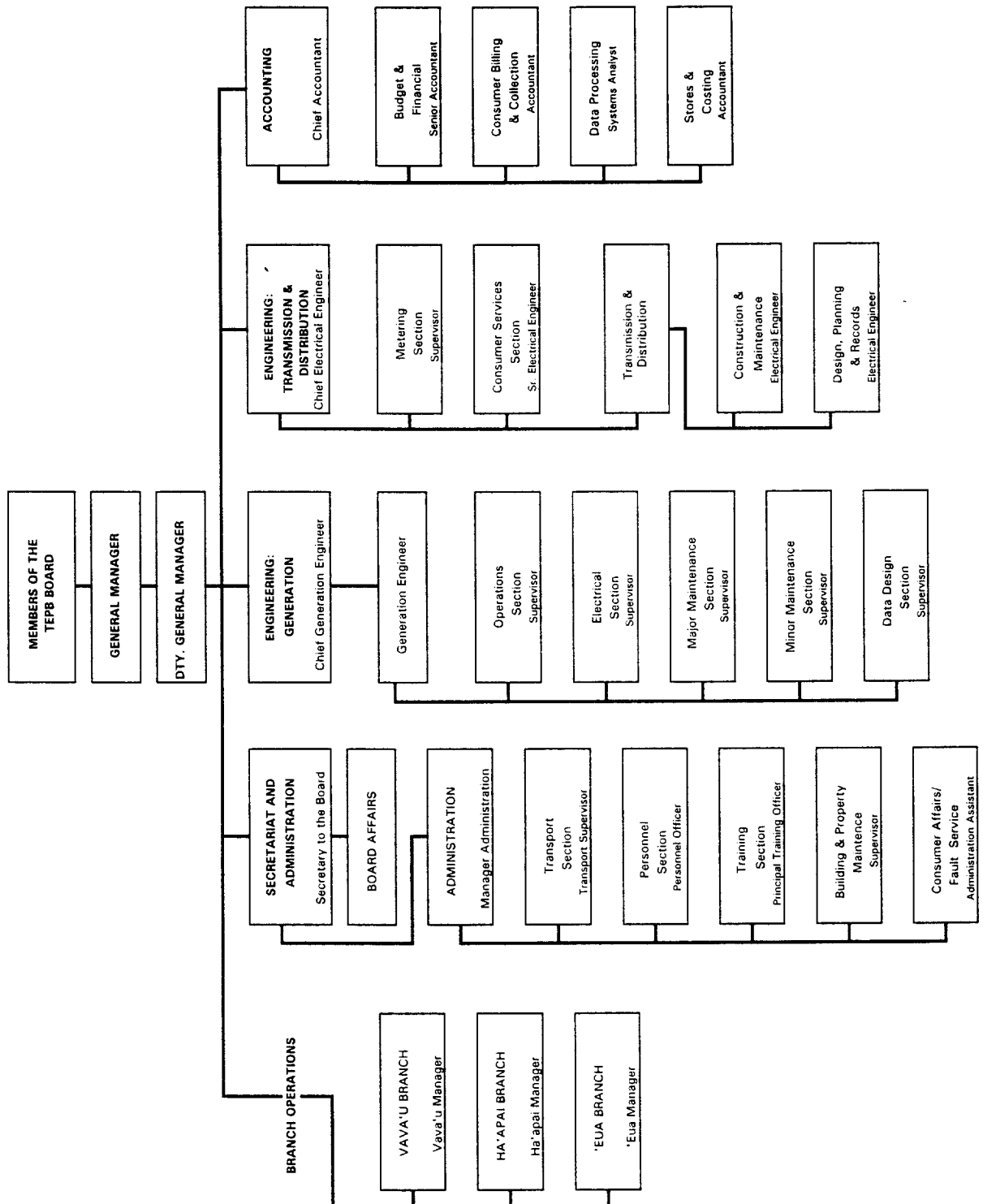
Total Population Served	=	Population Served by Distribution System
Daily Power Production	=	$\frac{\text{Energy Production}}{\text{No. Days in Month}}$
Consumption per Capita per Day	=	$\frac{\text{Consumption from all Consumers}}{\text{Population Served by all connections} \times \text{No. Days in Month}}$
Average Tariff (Total)	=	$\frac{\text{Billings for all Consumers}}{\text{Consumption from all Consumers}}$
Average Tariff (Domestic)	=	$\frac{\text{Billings for all Domestic Consumers}}{\text{Consumption from all Domestic Users}}$
Average Tariff (Commercial/ Industrial)	=	$\frac{\text{Billings for all Commercial/Industrial Consumers}}{\text{Consumption from all Commercial/Industrial Users}}$
Unit Energy Production Cost	=	$\frac{\text{O \& M Costs}}{\text{Total Energy Production}}$
Accounted for Energy	=	$\frac{\text{Metered Energy Use \%}}{\text{Total Energy Production}}$
Unaccounted for Energy	=	100% - Accounted for Energy %
Non-revenue Energy	=	$\frac{\text{Energy Production} - \text{Energy Billing GWh}}{\text{Energy Production}}$
Production Cost of Non-revenue Energy	=	O&M Cost x Non-revenue Energy
Opportunity Cost of Non-revenue Energy	=	Average Tariff x Non-revenue Energy

TONGA ELECTRIC POWER BOARD (TEPB)
BOARD MEMBERS
As of June 1996

- | | | |
|-----|---|---|
| 1. | Hon. Dr. S. Tapa
Minister of Health | Chairman |
| 2. | Hon. William Edwards
Minister of Police | Member |
| 3. | Mr. Taniela H. Tufui
Chief Secretary, Cabinet | Member |
| 4. | Hon. J.C. Cocker
Minister of Public Works | Member, representative of
consumers |
| 5. | Mr. Soane Kautai
General Manager, TEPB | Member exofficio |
| 6. | Mr. Lemeki Malu
General Manager,
Tonga Telecommunications
Commission | Member exofficio |
| 7. | Mr. S.T. Nakao
Businessman | Member, representative of
industrial consumers |
| 8. | Mr. Vuki Tangitau
Church Minister | Member, representative of
consumers |
| 9. | Mr. Sepa Mafi
Businessman | Member, representative of
consumers |
| 10. | Hon. Lasike | Member, representative of
consumers |

TONGA ELECTRIC POWER BOARD

Organization Chart



TONGA ELECTRIC POWER BOARD FINANCIAL STATEMENTS AND PROJECTIONS

Table 1: Income Statements, Year Ending June 30

(T\$'000)

Item	Unit	Audited				Projected										
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Sales	MWh	20,534	21,367	22,309	23,345	25,612	27,915	28,983	30,417	31,904	33,328	34,737	36,203	37,737	39,343	41,020
Transmission & distribution loss	%	14.4%	16.3%	15.5%	16.4%	15.0%	10.3%	10.2%	10.0%	9.1%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Av revenue yield, current prices	T\$/kWh	0.3179	0.3345	0.3635	0.3835	0.3790	0.3655	0.3731	0.3806	0.3882	0.3959	0.4039	0.4119	0.4202	0.4286	0.4371
Change	% / year	25.2%	5.2%	8.7%	5.5%	-1.2%	-3.6%	2.1%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Av revenue yield, 1996 prices	T\$/kWh						0.3655	0.3450	0.3383	0.3318	0.3254	0.3192	0.3130	0.3070	0.3011	0.2953
Consumers	No.	13,189	13,803	14,464	15,263	15,931	16,483	17,035	17,604	18,193	18,802	19,431	20,081	20,753	21,448	22,167
Specific consumption	kWh/consumer/yr	1,557	1,548	1,542	1,530	1,607	1,693	1,701	1,728	1,754	1,773	1,788	17,397	1,818	1,834	1,850
SALES REVENUE	T\$'000	6,527	7,147	8,109	8,952	9,708	10,204	10,813	11,576	12,384	13,196	14,029	14,913	15,856	16,861	17,932
Fuel & lubricants		3,704	3,872	4,486	4,274	4,061	4,266	4,750	5,049	5,292	5,553	5,846	6,160	6,489	6,861	7,250
Other recurring costs		2,303	2,592	2,451	2,364	3,068	3,489	3,438	3,746	4,051	4,555	4,882	5,379	5,836	6,369	6,901
Depreciation		471	503	615	812	1,790	1,832	1,456	1,375	1,413	1,695	1,915	2,133	2,168	2,208	2,246
Total costs		6,477	6,967	7,551	7,450	8,919	9,587	9,644	10,169	10,756	11,803	12,643	13,671	14,494	15,438	16,397
OPERATING PROFIT (Before interest, and before taxes)		50	180	558	1,502	789	617	1,169	1,406	1,628	1,393	1,386	1,242	1,362	1,423	1,535
Net nonoperating expense		(26)	(48)	29	209	2	0	0	0	0	0	0	0	0	0	0
Interest income		(39)	(3)	(32)	(31)	(36)	(20)	(22)	(22)	(12)	(7)	(13)	(36)	(86)	(139)	(192)
Overdraft interest		0	0	0	0	0	0	79	0	32	34	0	0	0	0	0
Fixed interest		25	91	139	219	127	898	818	829	921	1,003	1,013	963	913	849	772
Net finance costs		(14)	88	107	188	91	878	875	807	941	1,030	1,000	927	826	710	580
TAXABLE PROFIT		89	140	422	1,105	696	(261)	294	599	688	363	385	315	536	714	955
Income tax		0	26	127	361	224	0	73	165	191	94	101	79	146	199	271
NET PROFIT	T\$'000	89	113	295	744	472	(261)	221	434	496	269	285	235	390	514	683

Ratios:

Operating return on revenue	0.8%	2.5%	6.9%	16.8%	8.1%	6.0%	10.8%	12.1%	13.1%	10.6%	9.9%	8.3%	8.6%	8.4%	8.6%	8.6%
Return on net assets (equity)	1.9%	2.5%	5.7%	13.3%	7.7%	-4.4%	3.6%	6.6%	7.1%	3.7%	3.7%	3.7%	3.0%	4.7%	5.9%	7.3%
Return on average net fixed assets in service	1.1%	3.7%	10.0%	24.4%	8.4%	4.6%	8.8%	10.7%	13.9%	11.2%	9.1%	7.6%	8.9%	10.4%	12.7%	12.7%

Table 2: Balance Sheets, Year Ending June 30
(T\$'000)

Item	Unit	Audited					Projected									
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Assets																
Fixed assets at cost		8,937	9,809	11,527	12,399	20,551	24,182	24,350	24,632	25,441	29,192	34,322	35,623	36,327	36,934	37,618
less Depreciation		4,296	4,798	5,413	6,225	8,015	9,847	11,303	12,678	14,091	15,785	17,700	19,833	22,001	24,209	26,455
Net fixed assets in service		4,641	5,010	6,114	6,174	12,536	14,335	13,047	11,954	11,350	13,407	16,622	15,790	14,326	12,725	11,163
Capital works in progress							0	0	3,244	6,319	4,639	822	0	0	0	0
Fixed assets, net		4,641	5,010	6,114	6,174	12,536	14,335	13,047	15,198	17,669	18,046	17,444	15,790	14,326	12,725	11,163
Term investments		40	40	40	40	340	340	340	240	140	40	40	40	40	40	40
Cash & short-term deposits/borrowings		1,068	1,148	866	1,002	489	(1,131)	200	381	(285)	550	569	1,454	2,593	3,581	4,709
Noncash Working Capital																
Inventory		744	1,251	1,253	1,542	772	1,130	787	846	898	972	1,032	1,109	1,185	1,272	1,361
Trade debtors		668	783	1,064	1,567	1,966	2,991	2,080	1,892	1,905	1,903	2,023	2,151	2,287	2,432	2,586
Other receivables & unbilled energy		302	368	464	703	1,033	1,052	875	719	765	744	801	846	903	958	1,020
less																
Trade creditors & provisions		1,004	1,783	2,153	2,133	1,627	2,198	1,426	1,611	1,412	1,449	1,465	1,348	1,447	1,548	1,656
Taxation		0	310	127	658	662	97	73	165	191	94	101	79	146	199	271
Total Noncash Working Capital		709	309	500	1,020	1,483	2,878	2,242	1,682	1,965	2,075	2,291	2,679	2,782	2,916	3,039
TOTAL CAPITAL EMPLOYED		\$T'000														
Financed by:																
Grants & reserves		3,068	3,094	3,078	3,078	3,080	6,146	6,146	6,146	6,146	6,146	6,146	6,146	6,146	6,146	6,146
Retained profits		1,649	1,412	2,081	2,498	3,066	(261)	(40)	395	891	1,160	1,445	1,680	2,070	2,584	3,268
Total equity		4,717	4,506	5,160	5,576	6,147	5,886	6,107	6,541	7,037	7,306	7,591	7,827	8,216	8,731	9,414
Loan capital		1,742	2,001	2,360	2,660	8,702	10,536	9,722	11,037	12,476	13,552	12,916	12,300	11,688	10,694	9,699
TOTAL CAPITAL EMPLOYED		T\$'000														
months' revenues																
Accounts Receivables		1.2	1.3	1.6	2.1	2.4	3.5	2.3	2.0	1.8	1.7	1.7	1.7	1.7	1.7	1.7
Debt/Equity Ratio		0.4	0.4	0.5	0.5	1.4	1.8	1.6	1.7	1.8	1.9	1.7	1.6	1.4	1.2	1.0

Table 3: Sources and Applications of Funds, Year Ending June 30
(T\$'000)

Item	Unit	Audited					Projected									
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Sources																
Operating profit		75	228	529	1,293	787	617	1,169	1,406	1,628	1,393	1,386	1,242	1,362	1,423	1,535
Interest income		0	3	32	31	36	20	22	22	12	7	13	36	86	139	192
Depreciation		471	503	615	812	1,790	1,832	1,456	1,375	1,413	1,695	1,915	2,133	2,168	2,208	2,246
Decrease in noncash working capital		282	91	0	0	0	0	659	469	0	0	0	0	0	0	0
Internal funds generation		827	825	1,175	2,136	2,612	2,469	3,306	3,272	3,053	3,095	3,313	3,410	3,616	3,770	3,973
Debt capital drawn down		341	0	410	684	6,344	2,278	0	2,090	2,221	1,813	0	0	0	0	0
Reduction in working cash		0	0	282	0	513	1,621	0	0	766	0	0	0	0	0	0
TOTAL FUNDS AVAILABLE	T\$'000	1,168	825	1,868	2,820	9,469	6,367	3,306	5,363	6,040	4,908	3,313	3,410	3,616	3,770	3,973
Applications																
Capital expenditure		755	871	1,718	872	8,152	3,631	168	3,604	3,830	2,195	1,328	479	705	607	684
Increase in noncash working capital		0	0	9	1,051	466	831	0	0	310	14	222	367	169	187	196
Income tax		71	(284)	310	(170)	220	565	97	73	165	191	94	101	79	146	199
Loan repayments		0	244	389	385	364	443	814	775	783	737	637	616	612	994	994
Interest on long-term debt capital		25	91	139	219	127	898	818	829	921	1,003	1,013	963	913	849	772
Interest on short-term borrowing							0	79	0	32	34	0	0	0	0	0
Total debt servicing		25	335	528	604	491	1,341	1,711	1,604	1,736	1,774	1,650	1,579	1,524	1,844	1,767
Increase in working cash		328	80	0	136	0	0	1,330	81	0	735	19	885	1,139	988	1,128
Prior period & other adjustments		(11)	(178)	(698)	327	42	0	0	0	0	0	0	0	0	0	0
TOTAL FUNDS APPLIED	T\$'000	1,168	825	1,868	2,820	9,371	6,367	3,306	5,363	6,040	4,908	3,313	3,410	3,616	3,770	3,973
Debt-service cover		19.1	2.2	1.6	3.5	4.9	1.8	1.6	1.7	1.8	1.8	2.0	2.2	2.4	2.0	2.2
Self-financing ratio		97%	89%	19%	75%	18%	-7%	892%	44%	22%	51%	101%	285%	262%	263%	265%

COMPLIANCE WITH MAIN LOAN COVENANTS
Loan No. 1079-TON(SF): Power Development Project

Covenant	Reference	Status
I. LOAN AGREEMENT		
General		
The Borrower shall relend the proceeds of the Loan to TEPB under a Subsidiary Loan Agreement upon terms and conditions satisfactory to the Bank. Except as the Borrower and the Bank may otherwise agree, the terms for relending the proceeds of the Loan shall include interest at the rate of 8.5% per annum and a repayment period of 20 years including a grace period of 4 years. The Borrower shall bear the foreign exchange risk.	Sect. 3.01	Complied with. A Subsidiary Loan Agreement between the Government and TEPB was signed in May 1992.
The Borrower shall make available to TEPB, promptly as needed, the funds, facilities, services, land and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project.	Sect. 4.02	Complied with. Crown land was made available for the new Vava'u power station.
The Borrower shall furnish, or cause to be furnished, to the Bank all such reports and information as the Bank shall reasonably request concerning (i) the Loan and expenditure of the proceeds and maintenance of the service thereof; (ii) the goods and services and other items of expenditure financed out of the proceeds of the Loan; (iii) the Project; (iv) the administration, operations and financial condition of TEPB; (v) financial and economic conditions in the territory of the Borrower and the international balance-of-payments position of the Borrower; and (vi) any other matters relating to the purposes of the Loan.	Sect. 4.04	Delayed compliance. Project progress reports have been submitted late.
The Subsidiary Loan Agreement, in form and substance satisfactory to the Bank, shall have been duly executed and delivered on behalf of the Borrower and TEPB and become effective and binding upon the parties thereto in accordance with its terms, subject only to the effectiveness of this Loan Agreement.	Sect. 6.01	Complied with. The S.L.A. requirement was confirmed in the Legal Opinion.
Institutional/Financial		
Rate of Return: TEPB shall take all necessary measures to ensure that the ratio of its net revenues to its average net fixed assets in operation shall be maintained at a minimum of five percent (5%) for fiscal year 1991 and eight percent (8%) for each fiscal year after year 1991.	Sched. 6, para. 6	Partially complied with. The ROR increased from 2.5% in FY1991 to 21.6% in 1994 and decreased to 8.8% in 1995. It is expected to fall below 8% in 1996.
Debt Service: TEPB shall maintain its net revenues for each fiscal year at least 1.3 times the debt-service requirement for each fiscal year after fiscal year 1991.	Sched. 6, para. 7	Complied with. The DSR from FY1991 to 1995 varied between 1.6 to 4.5 times.
Tariffs: The Borrower and TEPB shall ensure that tariffs are maintained at level sufficient to meet the objectives of para. 6 & 7 of this Schedule. TEPB shall also ensure that a surcharge for fuel cost adjustment is included in the tariff to compensate for increase or decrease in the cost of fuel used for power generation.	Sched. 6, para. 8	Being complied with. The surcharge was deleted with approval of Bank based on the ADTA tariff study.

Covenant	Reference	Status
Upon completion of the study to be carried out by the TA consultants, TEPB shall, after consultation with the Bank, adopt such tariff level and structure as will ensure that TEPB satisfies its financial obligations set out in para. 6 and 7 of Schedule 6.	Sched. 6, para. 9	Complied with. A tariff adjustment was implemented by TEPB in July 1993.
Accounts Receivable: TEPB shall maintain its accounts receivable at a level not exceeding two months' sales revenues.	Sched. 6 para. 10(a)	Substantial compliance. Receivables increased from 1.1 months in FY1991 to 2.4 months in FY1995 and may exceed 3 months in FY1996.
Review of Act: The Borrower and TEPB shall complete a review of the Act, with the assistance of the TA consultants, and furnish the results of such review to the Bank for comment not later than 31 March 1992, or such other date that the Borrower and the Bank shall agree to, and enact amendments of the Act on the basis of the recommendations of such review.	Sched. 6, para. 11	Being complied with. A revised Act has been drafted and is scheduled to be considered by Parliament early in the 1997 session.
Project Related		
For the consulting services referred to in para. 1(a) of Schedule 5, a contract may be negotiated by TEPB with the consultants who were engaged to undertake the Power Development Study under TA No. 1250-TON	Sched. 5, para. 3(a)	Complied with. A contract was signed with C.I Power consultants on 22 May 1992.
TEPB, with the assistance of the Project Consultants, shall be responsible for project implementation. For this purpose, TEPB shall, no later than 30 April 1991, appoint a Project Manager satisfactory to the Bank and shall establish a Project Office, with day-to-day responsibility for project implementation, to ensure efficient and timely implementation.	Sched. 6, para. 1(a)	Complied with. TEPB's Chief Electrical Engineer was appointed Project Manager.
TEPB shall provide the Project Office with suitable facilities, including office accommodation, computer and communications equipment, vehicles and qualified technical and accounting staff. TEPB shall coordinate with the project consultants in the project implementation activities.	Sched. 6, para. 1(b)	Complied with.
The Borrower shall take all legal steps to assist TEPB in acquiring all lands and rights in lands, including leases and licenses, that may be required for the expeditious implementation of the Project or for the subject operation and maintenance of the Project.	Sched. 6, para. 2	Complied with.
TEPB shall design and implement, with the assistance of the Project Consultants, a program to reduce distribution energy losses on all its systems, with the view to reducing aggregate losses from the present level of about 13.5 per- cent of TEPB's total generation to levels below 10 percent.	Sched. 6, para. 3	Being complied with. The losses reduction program is ongoing, financed from the Loan.
TEPB, with the assistance of the Project consultants and in consultation with the Bank, shall undertake, or cause to be undertaken, project benefit monitoring and evaluation.	Sched. 6, para. 4	Partially complied with.

Covenant	Reference	Status
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II. PROJECT AGREEMENT

General

TEPB shall furnish to the Bank all such reports and information as the Bank reasonably request; TEPB shall furnish to the Bank quarterly report on the execution of the Project and on the operation and maintenance of the project facilities; promptly after physical completion of the Project shall prepare and furnish to the Bank a report on the execution and initial operation of the Project.

Sect. 2.08
(a), (b), (c)

Being complied with.
Quarterly reports generally delayed.
Final Report is due end-Dec 1996.

Institutional/Financial

TEPB shall furnish to the Bank its unaudited financial statements not later than six (6) months, and audited financial statements not later than nine (9) months, after the close of the fiscal year.

Sect. 2.09,
(a)

Partially complied with.
Statements' receipt have been delayed.

TEPB shall enable the Bank, upon the Bank's request, to discuss TEPB's statements and its financial affairs from time to time with TEPB's auditors.

Sect. 2.09,
(b)

Complied with.

TONGA ELECTRIC POWER BOARD INSTITUTIONAL AND FINANCIAL DEVELOPMENT STUDY

1. The consultants' report on the study contained the following main recommendations on the policy areas and also in the organization and staffing of TEPB.

1. Government Policy Issues

- (i) It was recommended that the purpose of TEPB — operation, maintenance, and development of the electricity system in an efficient and profitable manner to the best advantage of the Kingdom — should be incorporated in the legislation.
- (ii) The capital expenditure and operating costs of commercially uneconomic extensions of the network for social purposes should be charged to the Government, not to TEPB.
- (iii) Over time, TEPB should aim to operate on a fully commercial basis: bearing its full measure of costs and pricing its services so as to provide an appropriate standard of service and earn an adequate return on investment.
- (iv) The present Tonga Electric Power Board Act should be replaced by a new Act.
- (v) The Chief Executive's title according to the Act is "Manager." This should be replaced by the title of "General Manager" now in current use.
- (vi) The name of TEPB should be changed to the Tonga Electricity Commission.

2. Board Policy Issues

- (i) The role of the Board of Directors is to help achieve the purpose of TEPB. As such, the Board of Directors is a policy-setting body. The role of the Board of Directors is to
 - (a) set targets for current and future development;
 - (b) approve operating and capital budgets, power development works, and organizational and manpower plans;
 - (c) determine operating, financial and administrative policies; and
 - (d) monitor top management achievement of results, and take action if required results are not achieved.
- (ii) Approval by the Board of Directors of operation and maintenance expenditure estimates, shall be sufficient authority for the General Manager to expend the monies of the commission for the purposes specified therein

- (iii) The format of TEPB's budget and accounts should be in accordance with established commercial practice and international accounting standards
- (iv) The Board should agree to specific standards of performance and profit as a basis for measuring the management's performance
- (v) The Board should approve in principle the cessation of consumer contracting work in Tongatapu as the next step toward further privatization of these activities. The implementation of this step should be delayed until such time as the tariffs have been adjusted and the Board is achieving its revised profitability forecasts
- (vi) Salaries, superannuation, and conditions of service for executives and staff should be appropriate to the size and profitability of the organization and at least in line with those of other comparable utilities in Tonga.

3. TEPB's Mission Statement

2. The consultants' report contained a mission statement that has been presented to the Board: "TEPB's mission in the energy industry is to provide a reliable electricity supply wherever it is economic to do so on Tongatapu, Vava'u, Ha'apai, and 'Eua. In the process, TEPB is expected to

- (i) act in a commercial manner,
- (ii) achieve high levels of operational efficiency and safety,
- (iii) maintain a common retail price for electricity in different areas,
- (iv) ensure the development of management and staff,
- (v) improve customer relations and promptly give attention to complaints, and
- (vi) pay taxes and provide an adequate dividend return to Government."

4. Organizational and Staffing

3. The consultants' main recommendations under this topic were to

- (i) combine the responsibilities of the positions of Secretary to the Board and Manager-Administration in one position, that of Board Secretary;
- (ii) create a new position of Internal Auditor; and
- (iii) raise productivity by methods improvement combined with a program of staff reduction through termination, early retirement, nonreplacement, and management buy-out.

ADVISORY TECHNICAL ASSISTANCE — TERMS OF REFERENCE

A . TEPB Institutional Development

1. Objectives

1. The objective of this part of the technical assistance is to assist the Government and the Tonga Electric Power Board (TEPB) in the identification of areas for strengthening its organization and improving the efficiency of its operations, both technical and managerial/commercial. In recent years the organization's performance indicators have shown a weakening trend despite increases in sales and the installation of new plant and equipment in its power generating and distribution systems. Indicators such as sales per employee, overhead and administration costs per kilowatt-hour, have either worsened or not shown the improvement increased sales should allow. A review of TEPB's commercial and technical operations is therefore desirable to permit remedial measures such as strengthening of the organization's capabilities in certain areas.
2. A tariff study was carried out in 1992 by consultants engaged under the Bank's TA No. 1479-TON: Institutional and Financial Development. TEPB's tariffs were subsequently increased in 1994. Recent analysis, however, has shown a decline in the real value of the tariff levels and has indicated that a further increase may be necessary to meet higher operating costs and future investment programs, including the proposed Bank-assisted Second Power Development Project. Additionally, a lacuna exists in the area of street lighting charges, operation and control responsibility, ownership of facilities, and related issues. These matters need to be addressed under the proposed TA.
3. TA No. 1479-TON also resulted in the disposal of retailing activities and a review and redrafting of the Act governing the Board's activities, in which greater emphasis was placed on the commercial responsibilities of the utility and its Board and Management. The draft bill has not been passed by Parliament because of TEPB's past difficulties in presenting annual reports promptly.
4. TA No. 1479-TON also helped to introduce new computer systems for billing and consumer and financial accounting, design and install a modern budgetary planning and control reporting system within the framework of a comprehensive management information system (MIS). At the same time, a set of generation, transmission and distribution, and financial planning models was prepared to assist in determining tariff policy and rates.
5. TEPB has used its new accounting systems effectively and has cut the time from balance date to audit certificate from 15 months to 8 and plans to reduce it to fewer than 6 months in 1996. It therefore expects the new Act to be passed during the early 1997 session of Parliament and the obligation to operate on a fully commercial basis to become legally binding.

6. The Government has sought further technical assistance to advance its commercialization goals for TEPB by introducing appropriate governance and corporate planning procedures, integrating the financial planning and information systems and upgrading the application software systems used for preparation of MIS reports and financial planning.

2. Terms of Reference

7. The consultant will introduce an appropriate, simple process for preparing and updating a corporate plan for TEPB, which contains financial and operational performance objectives, strategies, and action plans. In the process the consultant will perform tasks under the following broad topics:

a. Corporate Planning and Development

- (i) Review the organization structure, existing staffing arrangements, and likely future tasks to be carried out; determine the minimum requirements to meet them, prepare responsibility center performance goals and objectives, job and person descriptions, and a personnel development plan
- (ii) Review the present performance appraisal and reward systems and make appropriate recommendations
- (iii) Examine and recommend the introduction of total quality management (TQM) or similar concepts to support staff development and continual improvement in key factors affecting financial, safety, and customer service performance
- (iv) Modernize the existing system and financial planning models and revise the Planning Handbook accordingly; ensure consistency between MIS, the planning models, and the objectives of each responsibility center; provide appropriate training
- (v) Review the administrative arrangements for procurement, installation, management, and operation of information technology systems and products throughout the organization with particular reference to economy, efficiency and security of data, equipment, and software; prepare standard practice instructions for recommended policies and procedures; indicate an appropriate development path; identify training requirements and recommend how they should be met
- (vi) Prepare a manual of corporate governance for the guidance of existing and future Directors and management, and conduct a series of workshops to introduce

b. Operational Policies and Procedures

- (i) Review the policies and procedures for the operation and maintenance of TEPB's power plants and systems and ensure that they are in accordance with appropriate modern practice and TEPB's financial, safety, and customer service objectives

- (ii) Review the adequacy of metering and instrumentation in the utility's power plants and systems so as to obtain sufficient operational statistics and data for the required levels of plant and system efficiency and financial accounting together with performance monitoring objectives; recommend measures to increase performance and efficiency of data gathering and logging, including the provision of recording instrumentation and/or simple computerized systems
- (iii) Review the operations and policies for billing and collections and recommend action to ensure that TEPB can achieve and subsequently maintain its collection rates at the levels achieved in the early 1990s.

c. Financial

- (i) Review the structure and level of TEPB tariffs in terms of the long-run marginal and average cost of supply to ensure that they continue to be simple while at the same time providing sufficient cash flows and appropriate signals to consumers; in particular, examine the scope for and desirability of (a) encouraging major consumers to take supply at 11 kV and introducing time-of-use rates, (b) progressively raising the rates on outlying systems to levels more nearly approaching full cost recovery
- (ii) Review the existing arrangements and responsibilities for street lighting; among other relevant matters, review the present ownership, control, policies, tariff, and payment arrangements for street lighting; recommend an equitable tariff for street lighting, ownership of facilities, and payment contributions from affected communities and recommend means for resolution of other relevant issues; coordinate with the Project implementation consultants (Second Power Development) on their study of street lighting technical issues
- (iii) Review and recommend the computerization of billing and other repetitive tasks in the outer island offices; assist in implementation of recommendations
- (iv) Assist the newly appointed Internal Auditor to draw up an audit program and provide ad hoc guidance on the introduction of audit procedures and practice
- (v) Identify weaknesses in the operation of existing financial and management accounting and information systems and make recommendations for modernization and upgrading the software used to produce MIS reports; update procedure manuals; identify training needs and prepare and give suitable on-the-job training
- (vi) Set out the content, format, and procedures for drawing up annual financial statements that conform to the laws of Tonga, the TEPB Act, the requirements of the Bank, and generally accepted accounting practice together with decision guidelines for disclosure of unusual events; make recommendations on the content of an informative statistical and performance review section of the annual report.

d. Staff Development

8. The development of general, financial, and operational management skills and abilities within TEPB is an important objective of the TA. The consultants' staff will therefore work with TEPB staff through one cycle of corporate planning, tariff review, annual balance, and preparation of draft financial statements and an annual report.

9. TEPB will assign members of management to work with the consultants' staff and to undertake as much work of the assignment as is practicable under their guidance. Twelve person-months is expected to be required over a period of about 18 months.

B. Rural Electrification

1. Objectives

10. The primary objective of the technical assistance (TA) will be to assist the Government and TEPB identify the issues and recommend solutions for the establishment and operation of rural and outer islands electrification schemes. Experience in Tonga and other small island countries has indicated an urgent need to address matters such as the optimal institutional arrangement, affordable charges and tariffs, and the ownership, operation, and maintenance of system facilities. There is substantial social, commercial, and other pressures to provide electric power services to rural areas of the larger Tongan islands and to outer islands of the archipelago. Outer island electrification is expensive to establish and operate in the Pacific islands because of long transportation distances, isolation, and the commensurate high cost of fuel, low load densities, and the high capital costs of alternative sources of electric power such as photovoltaic (PV) systems. Maintenance of these small systems also poses severe problems because of lack of trained personnel and the limited infrastructure as well as the difficulty/costs of interisland travel. Discussions with bilateral and other multilateral aid agencies assisting Tonga have indicated general agreement on a coordinated approach to the resolution of the various issues and the need for institutional and other arrangements to be in place before further large amounts of aid are made available in this area of the sector.

11. Systems installed to provide such remote rural or outer islands electric power systems are generally not self-financing in terms of cost recovery, given the need to set tariffs at affordable levels and which, generally, are not significantly higher than the tariffs charged for consumers connected to the country's main power systems. This inevitably leads to high Government subsidization. However, the subsidies are often inadequate to support the systems and, combined with administrative and technical lacunae, result in degraded systems that do not provide acceptable and reliable service.

12. The TA will identify the required arrangements to provide the facilities and manpower to provide reliable power supply to rural areas and outer islands of the country. The real costs of providing such services will be identified and the means by which these may be equitably and economically financed will be recommended. The TA will also review the suitability of existing and proposed systems from both a technical and economic viewpoint. The opportunity for alternative energy systems, such as PV and wind power - or hybrid systems - will be investigated in association with a review of the performance of similar existing systems.

e. Terms of Reference

13. The consultants will perform these tasks:

- (i) Review existing rural/outer islands power supply facilities, identify technical and operational weaknesses; review TEPB's role and facilities for rural/outer island electrification including its staffing, organization, administration, and financing/budgeting for these responsibilities; review the TEPB Act in terms of its exclusive mandate for national electricity generation/supply
- (ii) Review the Government's 1996 National Energy Policy Statement and Guidelines; comment on its implications for the Government's rural and outer islands electrification programs; suggest strengthening amendment where appropriate
- (iii) Identify and review the existing arrangements for outer island electrification, especially the role of institutions/Government agencies (such as the Energy Planning Unit, and others) in the supply of PV power to rural areas and the outer islands; review organizational arrangements of these institutions
- (iv) Report on the extent of the physical facilities (quantities and locations) presently under the control of these institutions, especially PV systems, and including the arrangement and financing of systems operation, maintenance, service/establishment charges, and general operating expenses
- (v) Identify and analyze the establishment and operating costs associated with these institutions' operations; identify current service and connection charges and their extent; estimate amounts of cost recovery presently being achieved for each system at the present tariff structure and rate; identify any subsidy or subsidies currently being applied to the power sector, especially those targeted at rural/outer island electrification
- (vi) Review project proposals for establishment of further outer island electrification schemes; review estimated capital and operating costs; examine the scope and technical/financial feasibilities of alternative means of supplying the levels of power needed;
- (vii) Review any earlier studies and reports undertaken relevant to the institutional, financial, and technical aspects of rural/outer island electrification in the country; review reports and studies undertaken on similar topics for other Pacific island countries (e.g. Kiribati, Tuvalu, the Marshall Islands) and examine the institutional arrangements developed and/or implemented for these countries
- (viii) Recommend a suitable institutional arrangement (including, but not limited to, retention of TEPB, formation of a semiautonomous TEPB division,

formation of a unit in a Government department, formation of a separate "micro-utility," etc.) to provide the required, sustainable power services

- (ix) Recommend suitable tariffs for different categories of rural/outer island services; if justified, recommend appropriate subsidies and/or cross-subsidies, and their method of application to ensure transparency to consumers, the Government, and TEPB.

C. Summary of Consulting Services

14. For Part A, an international consulting firm will be recruited to provide expertise in utility accounting, system economics, corporate organization planning, small-scale computing, financial planning, and internal auditing for small power utilities. For Part B, the firm will provide expertise in small power utility institutional organization, household PV systems, small diesel generation systems, power systems maintenance, and power utility finance and accounting.

PROJECT JUSTIFICATION AND FINANCIAL/ECONOMIC ANALYSES

A. Tongatapu Generation

1. Because the demand for power continues to increase, it was anticipated during formulation of the project preparatory technical assistance (PPTA) that the Tonga Electric Power Board (TEPB) would require additional diesel generating capacity for its Tongatapu system in the near term, which would constitute a potential major element for Bank financing from a loan programmed for 1996. However, the desire to limit borrowings, as well as to enhance the prospects of reducing tariffs prompted TEPB and the PPTA consultants to investigate the technical feasibility of the alternative of rehabilitating its four older Tongatapu system (Popua Power Station) diesel generating sets instead of retiring the units. The main task specified in the terms of reference of the TA was the investigation of a power generation development program for the Tongatapu system, which was TEPB's largest and which produced some 87 percent of the utility's electric energy production. The Appraisal Report of the first Power Development Project (Loan No. 1079-TON[SF]), for which the Bank's TA No. 1250-TON had drawn up TEPB's 1991 development plan, had anticipated retirement of the Popua power station units 1 & 2 in 1996, and units 3 & 4 in 2000 and 2002, respectively. Additionally, consideration was being given to the conversion of the two newer units (units 5 & 6 - provided under the Bank loan) to heavy oil fuel operation with the view to reducing operating costs.

2. Non-retirement of the older units will have a substantial effect on the need for new generation capacity in Tongatapu. A further aspect to be considered is the recent purchase of a 1-megawatt (MW) portable, high-speed peaking service diesel unit, which had been hired in 1994 to compensate for a capacity shortfall due to the delay in commissioning of the Bank-financed units 5 and 6.

B. Power Demand Statistics

3. The consultants reviewed the historical load growths in TEPB's four systems over the five years since the 1990 feasibility study (TA No. 1250-TON) for the first Power Development Project. It is seen that their 1990 projections (for the "median" scenario) were accurate for the Tongatapu system with average annual peak demand growth rate of 5.3 percent compared with an actual average growth of 5.4 percent. These figures contrast with the Appraisal Report estimate of 7 percent per annum. Tongatapu's peak load is now 5.0 MW, as against 3.85 MW in 1990.

4. Actual average demand growths in the three smaller systems of Vava'u, Ha'apai, and 'Eua have varied from 3.75 percent, 2.9 percent and 6.1 percent respectively, in the past five years compared with the consultants' 1990 projections of 6 percent, 9.3 percent and 5.9 percent. The Bank's Appraisal Mission in 1990 projected figures of 6.6 percent, 9.0 percent and 7.5 percent, respectively. Peak demands in these systems at the end of 1995 were 625 kilowatts (kW), 197 kW and 165 kW, respectively. The lower than expected growth in the Vava'u system is attributed to delays in commissioning the new generators and the lower than expected growth in tourism. Although peak demand growth for Ha'apai has been lower than forecast, energy generation has been close to that projected, especially in the past year.

In 'Eua, peak demand growth has met expectations; energy generation has been higher than projected, but the reason for that is not evident.

C. Demand Forecasts

5. From the consultants' 1990 forecasts, actual systems' performance over the past five years, and a review of expected economic, commercial, and other developments, the consultants have developed demand forecasts for the 10-year planning period specified in the PPTA's terms of reference. TEPB and the Mission have reviewed the forecasts and generally agree with the projected rates, except those for Vava'u. The consultants have assumed a substantial increase in tourism in Vava'u in the next two years. Additionally, it was assumed that a large distribution project in Western Vava'u, financed by TEPB, would be progressively commissioned in early 1997. The substantial boost in tourism, however, will not occur for at least two years after the assumed period because of a delay in arranging concessional financing for the extension of the airport runway to permit the operation of wide-bodied jet aircraft. Also, TEPB has already finished the full commissioning of the western distribution scheme. No further substantial load growth will therefore occur in the planning period. The adjusted energy sales growth projections for the two main systems, over two consecutive periods are shown below (consultants' original projections for Vava'u are in parentheses):

System	<u>Annual Energy Sales Growth (%/yr)</u>	
	1995-2001	2001-2005
Tongatapu	5.1	4.3
Vava'u	6.3 (7.6)	3.9 (4.4)

6. Electricity consumption between 1995 and 1996 grew rapidly in Vava'u where the growth is close to 20 percent. This high growth rate was caused mainly by the increase in public street lighting and, especially, by the expansion of the grid on the west side of the island. This discontinuity in the past trend cannot be extended in the forecast.

7. The average electricity demand growth for the period 1996 to 2006 is forecast at 3 percent per year. Energy production and sales forecasts to the year 2000 take into account the anticipated reduction of average distribution system losses to a level of about 8 percent. The assumptions incorporated in the electricity demand forecasts are conservative, thus underpinning the economic viability of the Project.

D. Capacity Balance and Reliability Criteria

8. The consultants have established the generating capacity required to meet the increasing loads of TEPB's four major systems. Concurrently, they analyzed the reliability criteria (reserve capacity margin) to govern this expansion. The objective of least-cost evaluation is to find the lowest cost (in economic terms), long-term generation expansion scenario that supplies the forecast demand at a specified level of reliability. For power systems of the size under study, a reserve margin capacity equal to, or greater than, the size of the largest generating unit in the system is utilized. That is, the generating plant power output must be able to meet or exceed the peak load when the largest unit is out of service either for maintenance or under forced outage (i.e. breakdown) condition. For higher reliability levels, a reserve margin capacity of equal to, say the largest plus a medium-size unit, or the largest plus the next largest unit may be considered. The latter generally provides the highest

economic reliability for smaller systems in that it permits the largest unit to be out of service for maintenance, and for the next largest unit to be forced out under an emergency situation.

9. In the 1991 generation development program drawn up under TA No.1250-TON, a reserve margin equal to the largest unit was utilized. TEPB has indicated to the Mission that it is satisfied with this margin, which has resulted in minimal load shedding in the intervening period.

E. Least-cost Development/Proposed Project Scope

1. Tongatapu

10. Given the intention of TEPB to utilize a reserve margin criterion of the largest unit, and to rehabilitate the four oldest units in Popua power station, (units 1 & 2, both of 1,200-kW nominal capacity, and units 3 and 4 of 1,730 kW), further new units for the Board's Tongatapu system are deferred until about 2003, in accordance with the peak demand and capacity balance projections of the consultants (refer to Appendix 19).

2. Vava'u

11. For a reserve margin of the largest unit, and with the impending retirement of the old Neiafu Power Station with an available capacity of 512 kW (due to commissioning of the new station financed from the first Power Project), the system needs two new 300-kW generators as early as possible. (Under the consultants' projections, two 500-kW units were recommended but the capacity required has been reviewed by TEPB and the Mission and consequently reduced.) New capacity will not be required until 2002 or 2003, unless load growth increases at a greater rate than projected.

3. Ha'apai

12. With the same reserve margin of one largest unit, additional capacity will not be required unless the two older 48-kW units are retired in the near future. Two 170-kW units were installed in 1994 (originally to be under Loan No. 1079-TON[SF] financing, but later financed by an AusAID grant).

4. 'Eua

13. With the existing old unit retained in service, new capacity should not be needed in the next 10 years. A 75 percent increase in peak demand would be needed to justify additional capacity, whereas only a 40 percent increase is forecast.

F. Economic Analysis

1. Tongatapu System

14. Within the present energy demand projections and in the absence of new generation investments, Tongatapu's power system will have a demand and supply gap close to 2 GWh in the year 2001; that gap will grow sharply in the following years to around 10 GWh at the end of the decade.

15. To match the demand increase, two possible technical options were identified: (i) new plant with characteristics similar to those of the generating units just installed at the site and (ii) to rehabilitate old plant and to thus prolong their economic life for 10 years or more. The first solution is characterized by higher investment costs but lower operation and maintenance and fuel costs as well as by a longer economic life.

16. The two alternatives deliver the same benefits in terms of energy (MWh) output and it is therefore possible to utilize the equalizing discount rate (EDR) methodology for comparison. The EDR (the discount rate at which the two alternatives are equal in value) is evaluated at 11.55 percent, which indicates that the rehabilitation option is the least-cost generation solution to supply the Tongatapu system through the next decade. See Table 1 for details of the least-cost analysis.

17. The rehabilitation option is compared with the "without the investment" option, assuming that the present generation system can continue to operate with an increase in cost and a decrease in availability and a loss of load probability of 15 percent of the largest plant in service. The economic analysis applies a border price correction factor of 0.8 for the investment and maintenance costs, and the standard correction factor of 0.7 for revenues. The consumer surplus is estimated at 15% of the present tariff level.

18. The financial internal rate of return (FIRR) for the base case is estimated at 12.2 percent, which compares satisfactorily with the real weighted average of capital for the utility. Details of the financial analysis are in Table 2. The proposed investment results are also economically favorable with an EIRR of 14.5 percent and an ENPV of around T\$465 thousand. (See Table 3 for the economic analysis). Sensitivity tests were carried out for both the FIRR and EIRR. The FIRR decreases to 10.8 percent, and to 10.1 percent when 10 percent capital and fuel cost increases are utilized, respectively. The following Table 4 shows the variations in ENPV and EIRR resulting from the assumed increases in capital and fuel costs and decreased energy output. The investment's economic feasibility is quite robust with major adverse movements in primary parameters with the EIRR not falling below 12 percent in any of the tested scenarios.

Table 4: Tongatapu Rehabilitation EIRR Sensitivity Analysis Summary

Item	Change	ENPV (T\$'000)	EIRR (%)	Sensitivity Indicator	Switching Value (%)
Base Case		465	14.5	-	-
Capital Cost	+10%	229	13.2	5.08	19
Fuel Cost	+20%	224	13.3	2.59	38
Energy Output	-10%	40	12.2	9.15	-11

2. Vava'u System

19. The economic analysis for the Vava'u system is less complex. Four 35-year-old diesel power generating units should soon be de-commissioned, and the least-cost solution to meet the present and projected demand is to install two new machines. In the "without the investment" scenario, the system will experience increased O&M costs and declining energy

supply in the following years. The willingness to pay for the electricity not supplied exceeds the cost to supply it.

20. The investment is feasible with an FIRR of 14 percent (see Table 5 for details) and an EIRR of 15.3 percent (Table 6) and an ENPV of around T\$105 thousand. The investment is robust with major deviations in variables. The FIRR decreases to 12.2 percent and 11.7 percent when assuming a 10 percent increase in capital, and a 20 percent increase in fuel costs, respectively. It decreases to 9.8 percent when a 10 percent decrease in output is utilized. The following Table 7 shows the modification of ENPV and EIRR with the assumptions of increased capital and fuel costs and decreased energy output.

Table 7: Vava'u Generation EIRR Sensitivity Analysis Summary

Item	Change	ENPV (T\$'000)	EIRR (%)	Sensitivity Indicator	Switching Value (%)
Base Case		105	15.3	-	-
Capital Cost	+10%	50	13.4	5.27	19
Fuel Cost	+20%	51	13.6	2.60	38
Energy Output	-10%	9	12.3	9.19	-11

3. Distribution Rehabilitation

21. Rehabilitation of the distribution systems, comprising both the upgrading and infrastructure improvement components, affects positively the costs as well as the benefits side. Lower losses are reflected in a lower variable cost to supply electricity demand and the additional sales resulting from improved systems' reliability increase the utility revenues, and also increase the users' benefit in terms of consumer surplus.

22. Comparing the investment cost and benefits, the investment is feasible with an FIRR equal to 8 percent, an EIRR of 13.2 percent, and an ENPV of T\$120 thousand (see Tables 8 and 9). The investment appears robust at major variables modifications. The following Table 10 shows the modification of ENPV and EIRR in the utilization of increased capital and fuel costs and decreased energy output. The FIRR decreases to 7 percent when either a 10 percent increase in capital costs or decrease in energy output is assumed.

Table 10: Distribution Systems EIRR Sensitivity Analysis Summary

Item	Change	ENPV (T\$'000)	EIRR (%)	Sensitivity Indicator	Switching Value (%)
Base Case		120	13.2	-	-
Capital Cost	+10%	-15	11.9	11.21	9
Fuel Cost	+20%	-82	11.1	8.44	-12
Energy Output	-10%	19	12.2	8.44	-12

Table 1: Tongatapu Rehabilitation Least-cost Analysis

Year	Demand Projections		New Power Plants		Rehabilitation		New Plant - Rehabilitation Output			New Plant - Rehabilitation Costs					Net Cash Flow (T\$'000)
	Peak Demand (kW)	Energy Demand (MWh)	Energy Supply (MWh)	Fuel Consumption (kl)	Energy Supply (MWh)	Fuel Consumption (kl)	Attributable Generation (MWh)	Energy Losses + Own Use (%)	Attributable Sales (MWh)	Sales Revenue (T\$'000)	Fuel Cost (T\$'000)	O&M Cost (T\$'000)	Capital Cost (T\$'000)		
1996	5,236	27,523	27,523	7,113	27,523	7,113	0	14.0							
1997	5,497	28,895	28,895	7,436	28,895	7,436	0	13.9					555	-555	
1998	5,749	30,215	30,215	7,800	30,215	7,800	0	13.4					327	-327	
1999	6,007	31,572	31,572	8,148	31,572	8,147	0	12.9					-600	600	
2000	6,212	32,653	32,653	8,441	32,653	8,440	0	11.9					-8	24	
2001	6,478	34,050	34,050	8,810	34,050	8,870	0	11.9	0	0	-17	-8		20	
2002	6,756	35,511	35,511	9,205	35,511	9,250	0	11.9	0	0	-12	-8		20	
2003	7,047	37,037	37,037	9,601	37,037	9,646	0	11.9	0	0	-12	-8		20	
2004	7,350	38,631	38,631	10,015	38,631	10,074	0	11.9	0	0	-16	-8		24	
2005	7,667	40,296	40,296	10,447	40,296	10,528	0	11.9	0	0	-22	-8		30	
2006	8,039	42,252	42,252	11,000	42,252	11,043	0	11.9	0	0	-12	-8		20	
2007	8,429	44,301	44,301	11,541	44,301	11,610	0	11.9	0	0	-19	-8		27	
2008	8,838	46,454	46,454	12,116	46,454	12,209	0	11.9	0	0	-26	-8		33	
2009	9,269	48,715	48,715	12,720	48,715	12,812	0	11.9	0	0	-26	-8		33	
2010	9,721	51,091	51,091	13,354	51,091	13,447	0	11.9	0	0	-26	-8		33	
2011	10,195	53,587	53,587	14,020	53,587	14,113	0	11.9	0	0	-26	-8		33	
2012	10,694	56,209	56,209	14,721	55,553	14,638	656	11.9	578	170	23	-8	-957	1,112	
EDR = 11.55%															

Table 5: Vava'u Generation Expansion Financial Analysis

Year	Demand Projections		Without the Project			With the Project			With - Without Benefits			With - Without Costs			Net Cash Flow (T\$'000)
	Peak Demand (kW)	Energy Demand (MWh)	Energy Supply (MWh)	Fuel Consumption (kl)	Energy Supply (MWh)	Fuel Consumption (kl)	Energy Supply (MWh)	Fuel Consumption (kl)	Attributable Generation (MWh)	Energy Losses + Own Use (%)	Attributable Sales (MWh)	Sales Revenue (T\$'000)	Extra Fuel (T\$'000)	O&M Cost (T\$'000)	Capital Cost (T\$'000)
1996	747	3,469	3,469	931	3,469	931	3,469	931	0	22.5	0	0	0	0	
1997	779	3,617	3,617	967	3,617	967	3,617	967	0	22.5	0	0	0	0	
1998	772	3,586	3,586	956	3,586	956	3,586	956	0	19.0	0	0	0	0	101
1999	746	3,463	3,463	931	3,463	931	3,463	931	0	13.0	0	0	0	0	460
2000	757	3,516	3,515	972	3,515	929	3,515	929	(0)	11.0	0	0	-21	0	509
2001	786	3,650	3,534	978	3,651	966	3,651	966	117	11.0	104	40	-6	14	31
2002	816	3,790	3,136	863	3,790	1,005	3,790	1,005	654	11.0	582	222	71	14	138
2003	848	3,937	2,809	767	3,938	1,046	3,938	1,046	1,129	11.0	1,005	384	138	14	232
2004	881	4,093	2,096	560	4,093	1,089	4,093	1,089	1,997	11.0	1,777	679	262	14	402
2005	917	4,256	2,025	542	4,255	1,134	4,255	1,134	2,231	11.0	1,985	759	294	14	450
2006	954	4,427	2,025	543	4,427	1,183	4,427	1,183	2,403	11.0	2,138	817	317	14	839
2007															
2008															
2009															
2010															
2011															
2012															

FIRR = 13.89%

Table 6: Vava'u Generation Expansion Economic Analysis (with and without the project)

Year	Demand Projections		Without the Project			With the Project			With - Without Benefits			With - Without Costs			Net Cash Flow (T\$'000)
	Peak Demand (kW)	Energy Demand (MWh)	Energy Supply (MWh)	Fuel Consumption (kl)	Energy Supply (MWh)	Fuel Consumption (kl)	Energy Supply (MWh)	Fuel Consumption (kl)	Attributable Generation (MWh)	Energy Losses + Own Use (%)	Attributable Sales (MWh)	Sales Revenue (T\$'000)	Extra Fuel (T\$'000)	O&M Cost (T\$'000)	Capital Cost (T\$'000)
1996	747	3,469	3,469	931	3,469	931	3,469	931	0	22.5	0	0	0	0	
1997	779	3,617	3,617	967	3,617	967	3,617	967	0	22.5	0	0	0	0	
1998	772	3,586	3,586	956	3,586	956	3,586	956	0	19.0	0	0	0	0	81
1999	746	3,463	3,463	931	3,463	931	3,463	931	0	13.0	0	0	0	0	368
2000	757	3,516	3,515	972	3,515	929	3,515	929	0	11.0	0	0	-3	12	407
2001	786	3,650	3,534	978	3,651	966	3,651	966	117	11.0	104	31	12	22	
2002	816	3,790	3,136	863	3,790	1,005	3,790	1,005	654	11.0	582	171	42	12	118
2003	848	3,937	2,809	767	3,938	1,046	3,938	1,046	1,129	11.0	1,005	296	82	12	202
2004	881	4,093	2,096	560	4,093	1,089	4,093	1,089	1,997	11.0	1,777	523	156	12	355
2005	917	4,256	2,025	542	4,255	1,134	4,255	1,134	2,231	11.0	1,985	584	175	12	398
2006	954	4,427	2,025	543	4,427	1,183	4,427	1,183	2,403	11.0	2,138	629	189	12	711
2007															
2008															
2009															
2010															
2011															
2012															

EIRR = 15.27%

Table 8: Distribution Systems Rehabilitation Financial Analysis

Year	Energy Sales (MWh)	Energy Generation		With - Without the Project				Capital Cost (T\$'000)	Net Cash Flow (T\$'000)
		Without Project (MWh)	With Project (MWh)	Generation Difference (MWh)	Sales Equivalent (MWh)	Lower Cost (T\$'000)	Additional Sales (T\$'000)		
1996	27,501	31,512	31,512	0	0	0			
1997	28,684	32,867	32,867	0	0	0			
1998	29,917	34,280	34,280	0	0	0		251	(251)
1999	31,204	35,754	35,754	0	0	0		1,142	(1,142)
2000	32,546	37,291	37,291	0	0	0		1,263	(1,263)
2001	33,945	38,895	38,156	739	636	122	124		245
2002	35,405	40,567	39,797	770	664	127	129		256
2003	36,927	42,312	41,508	803	692	132	134		267
2004	38,515	44,131	43,293	838	722	138	140		278
2005	40,171	46,029	45,155	874	753	144	146		290
2006	41,898	48,008	47,096	912	786	150	153		303
2007	43,700	50,072	49,122	951	819	157	159		316
2008	45,579	52,225	51,234	992	855	163	166		329
2009	47,539	54,471	53,437	1,034	891	170	173		343
2010	49,583	56,813	55,735	1,079	930	178	180		358
2011	51,715	59,256	58,131	1,125	970	185	188		374
2012	53,939	61,804	60,631	1,173	1,011	193	196	(1,328)	1,718

FIRR = 8.02%

Table 9: Distribution Systems Rehabilitation Economic Analysis

Year	Energy Sales (MWh)	Energy Generation		With - Without the Project				Capital Cost (T\$'000)	Net Cash Flow (T\$'000)
		Without Project (MWh)	With Project (MWh)	Generation Difference (MWh)	Sales Equivalent (MWh)	Lower Cost (T\$'000)	Additional Sales (T\$'000)		
1996	27,501	31,512	31,512	0	0	0	0		
1997	28,684	32,867	32,867	0	0	0	0		
1998	29,917	34,280	34,280	0	0	0	0	188	(188)
1999	31,204	35,754	35,754	0	0	0	0	856	(856)
2000	32,546	37,291	37,291	0	0	0	0	947	(947)
2001	33,945	38,895	38,156	739	636	85	190		275
2002	35,405	40,567	39,797	770	664	89	198		287
2003	36,927	42,312	41,508	803	692	93	207		300
2004	38,515	44,131	43,293	838	722	97	216		313
2005	40,171	46,029	45,155	874	753	101	225		326
2006	41,898	48,008	47,096	912	786	105	235		340
2007	43,700	50,072	49,122	951	819	110	245		355
2008	45,579	52,225	51,234	992	855	114	255		370
2009	47,539	54,471	53,437	1,034	891	119	266		386
2010	49,583	56,813	55,735	1,079	930	124	278		402
2011	51,715	59,256	58,131	1,125	970	130	290		420
2012	53,939	61,804	60,631	1,173	1,011	135	302	(996)	1,434

EIRR = 13.22%

TEPB SYSTEMS PLANT PROGRAM AND CAPACITY BALANCE

Item	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Tongatapu											
Total Generating Units	No.	7	7	7	7	7	7 ^a	7	7	7	7
Total Installed Capacity	kW	11,071	11,071	11,071	11,071	11,071	11,071	11,071	11,071	11,071	11,071
Total Available Capacity	kW	9,411	9,411	9,411	9,411	9,411	9,411	9,411	9,411	9,411	9,411
Less Largest Unit	kW	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816
Firm Capacity	kW	7,595	7,595	7,595	7,595	7,595	7,595	7,595	7,595	7,595	7,595
Peak Demand	kW	5,283	5,547	5,823	6,074	6,281	6,549	6,830	7,124	7,431	7,667
Capacity Balance	kW	2,312	2,048	1,772	1,521	1,314	1,046	765	471	164	-42
ditto	% peak	44	37	30	25	21	16	11	7	2	-1
Vava'u											
Total Generating Units	No.	6	6	4	4	4	4	4	4	4	4
Total Installed Capacity	kW	1,280	1,280	1,360	1,360	1,360	1,360	1,360	1,360	1,360	1,360
Total Available Capacity	kW	1,090	1,090	1,156	1,156	1,156	1,156	1,156	1,156	1,156	1,156
Less Largest Unit	kW	289	289	289	289	289	289	289	289	289	289
Firm Capacity	kW	801	801	867	867	867	867	867	867	867	867
Peak Demand	kW	747	779	772	772	774	786	816	848	881	917
Capacity Balance	kW	54	22	95	95	93	81	51	19	-14	-50
ditto	% peak	7	3	12	12	12	10	6	2	-2	-5
Ha'apai											
Total Generating Units	No.	4	4	4	4	4	4	4	4	4	4
Total Available Capacity	kW	416	416	416	416	416	416	416	416	416	416
Less Largest Unit	kW	160	160	160	160	160	160	160	160	160	160
Firm Capacity	kW	256	256	256	256	256	256	256	256	256	256
Peak Demand	kW	213	222	224	224	228	235	242	252	261	271
Capacity Balance	kW	43	34	32	32	28	21	14	4	-5	-15
ditto	% peak	20	15	14	14	12	9	6	2	-2	-6
'Eua											
Total Generating Units	No.	3	3	3	3	3	3	3	3	3	3
Total Available Capacity	kW	324	324	324	324	324	324	324	324	324	324
Less Largest Unit	kW	128	128	128	128	128	128	128	128	128	128
Firm Capacity	kW	196	196	196	196	196	196	196	196	196	196
Peak Demand	kW	180	188	188	186	191	199	207	215	224	233
Capacity Balance	kW	16	8	8	10	5	-3	-11	-19	-28	-37
ditto	% peak	9	4	4	5	2	-2	-5	-9	-13	-16

a Assumes Caterpillar unit is available for peaking service.